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SUMMARY

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Synthetic Bibliography

With special reference to the History of Science.

The following notes have been written, chiefly for the use of the readers and collaborators of *Isis*, as a contribution to the solution of this practical problem : « How to prepare a good bibliography of the history of science? » It is clear however that they may also help to solve other similar problems, or the more general one : « How to prepare a good encyclopaedic bibliography? »

(1) *Definitions.* — I propose to call *analytic bibliography*, that which is purely descriptive and whose object is chiefly to identify with certainty each bibliographic unit and to make a first classification, such as is embodied in the Decimal System for instance, of all the materials at hand. I propose to call *synthetic bibliography*, one which goes beyond this descriptive stage and attempts a judgment and a deeper classification, based upon a first hand study of the contents of each unit. It is clear that both *analytic* and *synthetic* are relative terms; a bibliography can be analytic or synthetic in an infinite number of degrees.

(2) *Analytic bibliography* has been carried on to a high stage of perfection by the best American libraries. Their catalogue cards are models of objective and extrinsic description. The task of preparing these cards and classifying them is not by any means as simple as a superficial observer may think. For example, the correct way of stating the name of the author, of transliterating titles written in other alphabets, of quoting the place and date of an edition, the number of its pages and plates, is not always easy. There are many pitfalls which the apprentice must learn to avoid. Yet all these difficulties can be solved by the application of rules, which however numerous are not hard to understand. The leading libraries have published elaborate codes of these rules, and are improving them all the time. The classification of the cards, that is, the determination of the subject words under which they should be indexed and of the cross references which should send the readers back to them, is even more difficult. Yet this also is chiefly a matter of routine, the appli-

cation of the many rules involved requiring not more than ordinary common sense and a moderate amount of encyclopaedic knowledge. The result of this analytic work is not simply the production of library cards, but also of many other publications. However, most of these are nothing but collections extracted from one or more library catalogues and published in book form. As examples of analytic bibliography I might quote the remarkable publications of the *Library of Congress* and of *The John Crerar Library* and also the *Catalogue of Scientific Papers compiled by the Royal Society* and the *International Catalogue of Scientific Literature*. The aim of all these publications is to offer lists as accurate and complete as possible, but in which every bibliographic item is placed on the same level. No attempt is made to distinguish between what is important or trivial, good or bad.

(3) *Insufficiency of analytic bibliography.* — Important, indispensable as these compilations are, they are and will become more and more insufficient. Scientific literature is suffering from two terrible diseases which are gaining ground every day: *overproduction* and unnecessary disintegration or *crumbling*. Overproduction is largely due to publishers and editors, who as soon as a topic becomes popular, cause a large amount of duplicate work to be devoted to it. The cost of printing and the fortunate fact that most scientific books do not pay, check overproduction to a certain extent, yet that hardly affects government institutions and universities some of which seem to believe that their usefulness will be measured by the number and the size of their publications. Besides, when economic conditons oblige publication to be restrained, it is not as a rule the worst and the least useful works which are sacrificed, because many of the men who have to decide which are worth publishing or not, are incompetent, and also because of the lack of adequate criticism, or to put it in another way, the indifference of the public.

I should not forget to mention a more fundamental cause of overproduction, although it affects more the total literary production, and relatively less the purely scientific literature, — that is the very existence of printing plants. Each plant must be kept working full time and that is only possible when a superabundance of manuscripts is always at hand. From this point of view, I am satisfied that the most effective way of checking the overproduction of books would be to reduce the number of the book-printing establishments. Their total

output and their output in certain classes of work might also be regulated without involving any sort of censorship.

Crumbling on the other hand, is encouraged by a false conception of specialization. Many authors, not only the younger ones, take specialization to mean that any result however trifling and provisional should be the subject of a separate paper. A botanist recently remarked (1).

"It must be obvious to most of us that our literature is crowded with the records of incompetent investigations. Not all who develop a technique are able to be independent investigators. They belong to the card catalogue class. They are not even able to select a suitable problem. We are too familiar with the dreary rehearsal of facts that have been told many times, the only new thing, perhaps, being the material used; and even then the result might have been foretold." Similar remarks might be made about any department of knowledge, but none is more crowded with bad reports of silly investigations than the History of Science. Some authors seem to have a real genius for disintegration. They find pleasure only in infinitesimal subjects. Some (I could easily quote names, but it would not serve my purpose any better to chagrin these otherwise good people) not only publish articles on the pettiest items, but they go so far as to print the tiniest chips of their studies, however incongruous they may be. I assume they mean well. Yet think of the inextricable confusion which would arise if every scholar were to do the same. A great deal of crumbling is also caused by vanity. An author allows himself to publish immoderately because of the excessive importance he attaches to his smallest findings. Another is forever publishing short communications to keep himself in the limelight. He believes that an interminable list of publications will increase his prestige and possibly foster his academic advancement. The saddest part of it is that he is not entirely wrong in believing so.

If these infinitesimal and immature publications were entirely worthless, one might throw them away and forget all about them. But the trouble is that none of them is entirely worthless; all deserve to be recorded somewhere. There is always reasonable hope of finding even in the crudest of them some precious material. Hence we are doomed to drag them along in our bibliographies, forever and ever. Another reason for quoting them all is that it is only fair to

(1) John M. Coulter in *Science*, vol. 51, p. 6.

give a chance to everybody and to publish at least the title of every paper however hopeless it may seem. This entirely justifies such an immense and ruinous publication as the *International Catalogue of Scientific Literature*. Time and money should not be spared to make sure that nobody be forgotten, who deserved however little to be known.

Yet it is clear that some antidote must be found. It is already easy enough to compile bibliographical lists of discouraging length on almost any subject, and as production increases at an accelerated rate one can not help asking oneself, — how long will these lists be in the future? To the novice, such lists are more bewildering than helpful, and they are apt to become really detrimental. What are we to do? Of course a system of scientific censorship is unthinkable beyond the limited realm of spontaneous and private endeavour. I see then only two ways out. The first is a preventive measure — moral pressure, to which I shall come back presently. The other, a remedy or shall we say, a palliative, — critical and selective bibliography. Apart from the complete lists, wherein all the items are put on the same level (and this can but mean : wherein the best are lost in the overwhelming mediocrity) there must be some select lists from which the deficient materials are as far as possible excluded or at least in which the best are given due prominence.

To show more concretely the injustice and the misleading nature of analytic bibliography untempered by criticism, let me quote an imaginary but very plausible example. The two famous historians, JACK and JOHN, have spent twenty years of their lives studying the development of physical theories. JACK has prepared quietly and steadily a " History of Physics ", which he was able to publish at the end of the twenty years. When it appeared the crowd of scholars paused for a moment and one could hear a ripple of applause. It was truly a monument of industry, intelligence and devotion. — JOHN has preferred to publish the results of his studies in the shape of fragments and in the course of those twenty years he has given out not less than a thousand papers, — some long, some short, some very short indeed, but none of them insignificant. The aggregate of these papers scattered among more than fifty different periodicals is also a history of physics, but of course with many gaps and without connection and proportion between the parts. Moreover very few students have at hand the whole of JOHN's writings, and for the average reader many of them have become practically inaccessible. It is clear

that JACK has achieved far more than JOHN, for he has not only carried on the same investigations (1) but besides he has taken considerable pains to reassimilate all of the materials obtained and to build out of them a complete, coherent and harmonious whole. JOHN is simply a collector and polisher of materials; JACK is that too, but furthermore he is a builder. Now in an analytic bibliography of the history of physics, JOHN would be quoted a thousand times and JACK but once, and I may add that while the average space given to one of JOHN's titles is about three lines, it takes less than two lines to quote JACK's solitary book. Don't you see the injustice and the stupidity of it? Injustice to JACK and JOHN and source of confusion to the reader. Many know JOHN, who has stood signalling in their path for twenty years; they hardly know JACK, especially if they were absent when his book appeared.

The aim of synthetic bibliography is to make JACK better known, that is to increase not only his fame but the practical value of his work, — while giving sufficient credit to JOHN. And mind you, I have assumed that JOHN too was an expert scholar, and that nothing of what he wrote was insignificant. Just imagine the injustice and the confusion caused in the far more numerous cases when JOHN is simply a mediocre creature, suffering from an excessive literary pruriency! It is horrible.

It is necessary to insist on the importance of the moral education of young scholars, as the only preventive measure. This part of their education is too often neglected. For one thing, many teachers are too mediocre themselves to impart it : how could they give a counsel of abnegation and silence when they themselves come out in print far more often than they should? Indeed, instead of checking premature publication they are often the very instigators, the real culprits. They have a notion that the more their students publish, the greater will be their own renown. This notion is wicked, but not incorrect. It should be the duty of any teacher to insist upon the moral responsibility incurred by anyone who publishes anything. He should explain repeatedly to his pupils that in the last analysis the number of a man's publications is of very little account, and that, if inordinate and premature writing may bring him some temporary advantage, it

(1) It must be noted that he has been able all the time to take advantage not simply of his own but also of JOHN's results. By the way, JACK is the only man, but JOHN, who has a complete collection of the latter's papers.

is bound to cause him permanent harm. The fame of a scholar rests ultimately upon the quality of his work, not its quantity, and even more upon the value of his inspiration. SOCRATES did not write anything. The teacher should urge his pupils not to be too anxious to publish whatever they may discover, but to wait and think, to let the subject grow and mature in their own minds, to submit it to their friends and to invite in any possible way preventive criticism.

The purpose of critical bibliography is to make a first sifting of the materials; not so much to discard indifferent work as to focus the attention upon the best. Its unremitting exercise will surely if slowly thwart bad and immature publication.

(4) *Synthetic Bibliography.* — The purpose and nature of synthetic bibliography, as opposed to analytic bibliography, has been made sufficiently clear in the preceding chapter. It must be *selective, critical* and *constructive.* — In this section, I propose to explain briefly how such synthetic bibliography should be organized; in the following one the application of these ideas to the particular bibliography included in *Isis* will oblige me to go into some practical details.

First of all, a common objection must be met. It is often said that a real scholar does not need any bibliography because he knows it. It is true that a mature scholar has the bibliography of his subject on the tips of his fingers and knows generally more about the books that he uses than could ever be printed. But how would he know the value of the new books and papers published all over the world? Besides however much he may know, a good bibliography will teach him a lot and the possession of such a valuable tool will ease his memory. The first humanists had no Greek dictionaries and some of them may have objected to their compilation in the same way that selfish pedants object to the elaboration of good bibliographies. Yet the dictionary is of far greater use to an accomplished Hellenist than to a schoolboy, although the former could do without it far more easily than the latter. But irrespectively of all that, the old scholars die every day and new ones must be able to take their place. As the field of knowledge increases while the span of life does not, we must help in any possible way the young to get more quickly to the front.

The duty of the analytic bibliographer is to give *all* the titles; ours is to include everything which is important, to place it in its proper perspective and to exclude everything which is not important, with plenty of exceptions however. For example, it is a duty to denounce

briefly a plagiarism or to state the futility of a book which might easily be mistaken for an important one. After having described a paper in the same way as the librarian does (perhaps less fastidiously, because we are more interested in its contents than its external appearance) one must try to appreciate it tersely asking oneself the following questions : " What is the author's aim? What sources did he use? How did he use them? Is his work original and to what extent? What is his point of view or his bias? What are the main results of his enquiry? (quoting them if it can be done briefly). What are the main errors? (*Idem*). To what extent did the author accomplish his purpose? What other enquiries does his own suggest? " In a great number of cases it is possible to answer these questions adequately in a few lines.

Of course the elaboration of such a bibliography is a very nice task, for which no fixed rules can be prescribed. It cannot be made " foolproof „ in the same way as analytic bibliography. But the following remarks may be helpful.

In case of doubt, for instance, as to whether to include or to exclude a paper, it is better to be generous. It is always safe to be generous. Some critics seem to be happy only when they can find fault and the running down of an author gives them malicious pleasure. Their criticism is not really synthetic because it is seldom constructive. Such men are more to be pitied than hunchbacks; they are moral hunchbacks. I believe that they suffer more than their victims. When a book is bad it is easy enough to suggest it without being unnecessarily hard; in most cases it is better still to abandon it to its Nemesis.

In the appreciation of what is important and what is not, there is a frequent cause of error which I must point out. One is easily led to believe that what is not important for one's own studies or from one's own particular point of view is not important at all (and *vice-versa*) (1).

Any critical note however short should be signed. This increases the responsibility of the critic and the confidence of the reader; it enables the latter to weigh the criticism.

I said above that to be truly synthetic, a bibliography must be selective, critical and constructive. The two former qualities have

(1) I have found innumerable examples of this source of error in the *Mit. zur Gesch. d. Med. u. Naturw.*

been sufficiently explained. Those who collaborate in a bibliographical undertaking must take the necessary pains to insure good selection and good criticism; it is then the editor's task to make their common work constructive. It becomes constructive indeed because of the unity of purpose and of the selection and classification of the materials. Such a bibliography whereof all the irrelevant items have been once more weeded out and wherein each of the others has been put at its right place, is already a true synthesis, or at any rate the skeleton of a synthesis.

(5) *Synthetic Bibliography of the History of Science.* — Let us now consider more closely one particular synthetic bibliography, namely that which is one of the main features of *Isis*. It is essentially devoted to the History of Science, but as the History of Science is intimately connected with the Organization [1] and the Philosophy of Science, and also with the History of Civilization, its scope has been enlarged so as to include subsidiarily all that and it is entitled " Critical Bibliography of the History, Philosophy and Organization of Science and of the History of Civilization „ [2].

The aim is to include in it critical notes relating to all important publications and to a good many less important ones, which may be of any interest to the historian of science. Many books or papers dealing with connected subjects are also included if they be deemed sufficiently important. For example, it is clear that a good history of religions or a memoir which introduced into this history a radically new point of view or set of facts, must be at least quoted because the historian of science will have to refer to it, but it is of course out of the question to publish a complete bibliography of the history of religions. The same remark may be made about any of the other secondary topics of our bibliography (see list below).

The reproach has been made that the scope of our bibliography was too wide and too vague; that such an encyclopaedic survey could not be adequately accomplished. This reproach does not seem to be justified. It is true ours is an encyclopaedic bibliography, but one made from a particular point of view, and that restricts its field considerably. Its purpose — to collect the materials which the

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(1) The word *Organization* has been defined in : « Le but d'*Isis* », *Isis*, vol. I, p. 193-196, 1913.

(2) I call it « critical » and not « synthetic » bibliography, simply because I consider that it is not yet good enough to be called synthetic.

historian of science may need — is great but not vague, and moreover the classification is so minute that any definite question will find in it a definite answer.

The scope is international, with the two following qualifications however. In the first place, while great pains are taken to include everything of any importance published in the five international scientific languages (English, German, French, Italian and Latin). I do not trouble as much about papers published in other languages. It is legitimate to assume that scholars discarding the use of every one of these five languages had no real wish to find an audience in the whole Republic of Letters.

In the second place, the Bibliography itself is now chiefly written in English instead of being tetraglot as before. This has been done to increase its international influence, for there are far more people able to read English than to read English plus the other languages. To illustrate the international scope of our bibliography I need only mention that the books and papers reviewed or mentioned in the present number of *Isis* aggregate about 495 of which 209 were published in the German countries, 114 in America, 66 in Italy, 63 in England and 36 in France. The German publications are far more numerous because many of them could not be included in the previous bibliography on account of the war. It would not be judicious to draw conclusions from the comparison of these figures which relate to only one number of *Isis*, because small accidents may modify their proportions and also because the bibliography is still very imperfect. But its genuine internationalism is manifest.

The following facts will illustrate the selective process upon which our bibliography is based. Of course the collaborators do not write critical notes at random. They make a first choice. Moreover of all the notes in hand at the time of closing the eighth bibliography (that is the bibliography of the present number), only about *one sixth* was finally included, one third being rejected, and one half being postponed. The postponed materials are chiefly made up of secondhand notes which will be included (or rejected) as soon as the original publications have been studied; they form the first stock of notes for the next bibliography. Hence at the moment of editing a bibliography, I have already at hand double the material for the next one.

The items finally accepted are classified in the following way. The chief purpose of *Isis* being an historical one, the fundamental classification is chronological. As no historical periods are universal, it

has seemed simpler to adopt the artificial classification by centuries. Because of its conventional character, this classification is universal and unbiassed. All the items relating to a period of time not greater than two centuries, are classified by centuries (1). In a second part, the items relating to longer periods are classified if possible, according to some other historical periods (antiquity, middle ages, Greece, Rome...) or to historico-racial divisions (China, Islam, Israel...) Finally, the items which could not be included in either of the two first parts, are classified in the third part by subject (astronomy, botany, religion...), the various topics being placed in alphabetical order. This third classification is exhaustive because its last subdivision is entitled *Alia*. The complete plan of classification follows :

PART I. — Fundamental Classification (centurial).

..., S VIII A. C., S. VII A. C., ..., S. I A. C., S. I, S II, ..., S. XX.

The last subdivision is followed by a list of chiefly biographical obituary, notices entitled « Materials for the biography of contemporary scientists and scholars ».

PART II. — Historical Classification.

1. Antiquity.
2. Antiquity, classical.
3. Asia (Central, Eastern, Western).
4. Babylonia and Assyria.
5. Bible (Old Test. civil).
6. Byzantium.
7. China.
8. Egypt.
9. Greece.
10. India
11. Iran.
12. Islam.
13. Israel.
14. Japan.
15. Middle Ages.
16. Rome.

PART III. — Systematic Classification.

1. Anatomy.
2. Anthropology.
3. Archaeology, museums and collections.
4. Art, art and science, iconography.
5. Arts and Crafts.
6. Astronomy, geodesy, meteorology and terrestrial physics.
7. Bibliography and libraries.
8. Biology.
9. Botany.

(1) Items dealing with periods longer than one century and shorter than three, are classified under one of the two centuries they deal with : the most important, or if equally important, the earliest.

10. Chemistry.
11. Economics (econ. doctrines and hist., commerce, transportation, communications).
12. Education (methods and institutions).
13. Ethnology, primitive and popular science.
14. Geography.
15. Geology, mineralogy, palaeontology and mining.
16. History of civilization. Histor. methods. Biography and chronology.
17. Language and literature.
18. Logic and theory of knowledge.
19. Mathematics.
20. Mechanics.
21. Medicine : *a*) Hist., Organisation and Philos.
    b) Epidemiology.
22. Morals. Moral organ. of society.
23. Pharmacy, pharmacology.
24. Philos. Science and philosophy.
25. Physics.
26. Physiology.
27. Prehistory.
28. Psychology.
29. Religion. Science and religion.
30. Science : *a*) Bibliography;
    b) History;
    c) Organization;
    d) Philosophy.
31. Sociology, jurisprudence and positive polity.
32. Statistics.
33. Superstitions and occultism.
34. Technology.
35. Zoology
36. Alia.

t is well to repeat that Part I is the fundamental classification, that Part II is only the residue of Part I and that part III is only the residue of part I and II. Of course it would be better to quote each paper twice if necessary, for inst. one on « Geology in the fourteenth Cent », both under S. XIV and geology, but that would double the length of the bibliography and it did not seem worth while. No classification will satisfy everybody. I can only say in support of mine, that it is the result of nine years experience and that it will prove useful to any historian who will first take the very small trouble of studying it.

This classification has been devised to serve the purpose of the historian of science, rather than the purpose of historians of particular sciences, and to spread the notion of the History of Science, considered as a well defined discipline. It has a real didactic value for no one who uses it will ever be able to forget that all the branches of science have developed together, that this development is truly universal and that the history of science is an essential part of the history of civilization.

(6) *Conclusion.* — The writing of conscientious critical notes is a difficult task and one which calls for abnegation. But the writer is

rewarded by the knowledge that this sort of work is extremely useful. If he does it well he renders a real service both to reader and to author. The idea of service must be his constant inspiration. In case of doubt it will be his guide; he has only to ask himself — « How shall I serve best? Which information will be most helpful? » and the correct way of stating his criticism will come to his mind.

Let us hope that all the contributors to *Isis* will be willing to do their share of this work. We need the best men to do it, and we need many of them in order that none be obliged to do too much of it. There may be some people who like bibliographic work for its own sake as there are others to whom the computation of mathematical tables gives intense delight. But I suppose these are exceptional cases. Most people cannot, do much bibliographic work without feeling stale. Futhermore it is an excellent intellectual pratice to alternate original and critical work. *Indeed no critical work can be done very well for a long time*, because he who does not himself investigate, is bound to deteriorate and to become gradually less able to criticize in a really constructive way. That is the main reason why synthetic bibliography cannot, as a rule, be undertaken by librarians. Therefore it is a matter of solidarity for all scholars to cooperate in the accomplishment of this public service. Some will perhaps say that they cannot participate because their own original work is too important. Possibly. But it is often those who are least original who are most jealous of their originality. As a matter of fact good critical work may prove to be more original than many so-called original contributions. It is not what one does that matters, but *how* one does it.

Critical work must be approached in a spirit of service or left untouched.

GEORGE SARTON.

Washington, D. C., April 24, 1920.

Bibliographical note. — GEORGE SARTON, « Recommandations aux collaborateurs d'*Isis* », Wondelgem, 1912, 3 p.; 2d. ed. enlarged and revised, Wondelgem 1914, 8 p. These two papers, both privately printed, are superseded by the present one.

Apart from the *Critical Bibliographies* other synthetic studies have been published in *Isis* as follow: G. SARTON, « Bibliographie synthétique des revues et des collections de livres », vol. II, p. 125-131, 1914; « Soixante-deux revues et collections relatives à l'histoire des sciences », *ibidem*, p. 132-161; P. MASSON-OURSEL, « Bibliographie sommaire de l'Indianisme », vol. III, p., 172-218, 1920. G. S.

Bibliographie sommaire de l'Indianisme

La présente bibliographie prétend fournir un aperçu synthétique forcément, mais délibérément très sommaire, sur les travaux essentiels de l'indianisme, non pas dresser un répertoire analytique du plus grand nombre possible de ces travaux. Cette dernière tâche serait presque infinie ; la nôtre est nettement circonscrite. Dans la même mesure, elle sera partiale autant que partielle : tout choix implique de l'arbitraire. Pourtant, quoique nous omettions un grand nombre d'ouvrages de haute valeur, nous espérons présenter l'indication des plus essentiels et nous sommes sûrs de fournir indirectement, par ceux que nous mentionnons, le moyen au lecteur d'accéder à ceux que nous passons sous silence, surtout s'il recourt aux bibliographies spéciales, dont l' « Orientalische Bibliographie » est le spécimen le plus achevé, approximativement parfait.

Nous prétendons aussi peu à esquisser un tableau de l'état actuel de l'indologie, qu'à établir l'inventaire des œuvres où se réalise cette science. Il est devenu presque impossible aux plus experts et aux plus laborieux indianistes de maîtriser dans sa totalité la discipline à laquelle ils collaborent ; le temps est déjà loin, où la philologie sanscrite et l'histoire de la littérature composée dans cette langue épuisaient le contenu de l'indologie ; bien d'autres idiomes, antiques, médiévaux ou modernes s'imposent à notre examen ; toutes sortes d'organisations sociales, de dogmes religieux, de doctrines spéculatives, de règles juridiques, de formes d'art requièrent, pour être objectivement appréciées, des compétences autres que celle du pur linguiste. Des découvertes archéologiques ont donné lieu à l'institution d'une paléographie, d'une numismatique, d'une épigraphie, d'une iconographie indiennes. Le renvoi aux travaux les plus récents et les plus importants renseignera les chercheurs plus que ne le saurait faire un résumé superficiel des résultats acquis ou en voie

d'acquisition. Une telle revue, d'ailleurs, devient de plus en plus ardue à exécuter, ainsi qu'en témoigne l'assiduité décroissante des indianistes les plus qualifiés à fournir de ces « Jahresberichte » dont Klemm et Printz, Aug. Barth et L. Finot ont donné de remarquables modèles (1).

Nous n'aspirons pas davantage à retracer, fût-ce très brièvement, l'histoire de l'indianisme ; notre énumération chronologique des bibliographies d'orientalisme permettra cependant de s'orienter en ce domaine. Mais nous ferons abstraction des œuvres qui, bien qu'elles aient exercé, en leur temps, une influence notoire sur la compréhension des faits, des écrits ou des doctrines, n'offrent plus aujourd'hui qu'un intérêt de curiosité rétrospective. Ainsi, nous nous abstiendrons de rappeler l'*Oupnek'hat* d'Anquetil Duperron, quoique cet ouvrage ait marqué le point de départ de presque toute notre information relative à la littérature brahmanique. Pour prendre un autre exemple, nous ne signalerons pas le *Nalus, carmen sanscritum e Mahabharato*, de F. Bopp, bien que cet essai de traduction ait servi de propédeutique à l'initiation de maintes générations de linguistes ; tandis que nous ne manquerons pas de citer, du même auteur, ses ouvrages grammaticaux qui demeurent en droit, comme ils furent en fait, des fondements de la philologie comparée.

Notre dessein est fort restreint, mais nous souhaiterions de l'accomplir d'une manière positive : nous formons le ferme propos de ne signaler que des ouvrages susceptibles de servir d'instruments de travail. Notion sans doute peu précise, car des œuvres vieillies, des œuvres même qui à leur époque furent médiocres, peuvent fournir des suggestions précieuses à d'ingénieux esprits. Un effort d'explication hypothétique, en inspirant des recherches nouvelles, peut constituer un instrument de travail aussi utile à sa manière qu'un catalogue ou qu'un dictionnaire. Tous les degrés intermédiaires se rencontrent entre l'essai original de reconstitution d'une doctrine ou d'une histoire et le simple exposé de vulgarisation ; ce dernier genre, en dépit

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(1) KLEMM, in *Zeitschrift der deutschen morgenl. Gesell.*, LVIII, 1904.
PRINTZ, in *Wiener Zeit. f. d. Kunde des Morgenlandes.*
BARTH, « Bulletins » parus in *Revue de l'Hist. des Religions*, réédités dans ses œuvres complètes, sous ce titre : « Quarante ans d'Indianisme ». Les tomes I et II ont paru en 1914, le tome III en 1917, à Paris, chez Leroux.
L. FINOT, in *Journal Asiatique.*

de son insignifiance scientifique, remplit un office indispensable pour l'initiation des nouveaux venus à ces études ; et les plus avertis en certaines matières restent des profanes en d'autres compartiments de la science même à laquelle ils se consacrent. Pourtant nous veillerons à écarter de nos listes, pour des raisons parallèles, mais contraires, deux catégories d'ouvrages. D'abord ceux de simple vulgarisation, même s'ils joignent la clarté à une certaine précision. Mais aussi les publications de textes originaux parus dans les diverses « séries » dont nous indiquerons les principales : seuls en peuvent tirer parti les érudits qui n'ont que faire de consulter ces pages. Nous visons moins à documenter qu'à présenter le plus élémentaire outillage de la technique indologique.

Nous nous attacherons, en particulier, à faire le bilan des disciplines afférentes à l'indologie et à déterminer les diverses voies d'accès à l'étude des faits historiques hindous. Si l'on peut, dans une très large mesure, restituer l'histoire de la Grèce ou celle de la Chine par l'examen des matériaux laissés par ces deux civilisations, une tâche analogue semble irréalisable en ce qui concerne l'Inde, insoucieuse à toutes les époques de connaître et de faire connaître son propre passé. On n'a réussi à fixer quelques dates précises dans cette longue évolution qu'en recourant à des documents extra-indiens. Les plus importants se rencontrent dans la littérature ou dans les annales du Tibet et de la Chine. Les civilisations de l'Indo-Chine, de l'Insulinde, du Japon peuvent en outre fournir maints témoignages. Les récentes explorations en Asie Centrale ont exhumé des types de langages et des fragments d'œuvres qui résolvent ou qui posent des problèmes indologiques. Les textes grecs dans l'antiquité ; une certaine propagation du christianisme dès ses origines ; l'histoire, depuis notre Renaissance ; des voyages maritimes accomplis par les Européens bientôt en posture de conquérants, non plus simplement de navigateurs : voilà autant de facteurs occidentaux dont il ne faudrait pas faire abstraction. Moins encore peut-on ignorer les matériaux que fournissent l'Arabie et la Perse islamiques sur un pays devenu en partie musulman. S'il faut attendre longtemps encore non seulement les résultats qu'apporteront toutes ces études, mais les dépouillements de textes, la constitution des inventaires ou des lexiques préliminaires à de telles entreprises, nous avons le devoir de signaler, si rudimentaires soient-ils, les moyens d'enquête dont, dès à présent, nous disposons. Donner le sentiment de la complexité croissante de l'indianisme, est croyons-nous, un moyen de le servir, car ce peut être une occasion de faire

appel aux compétences les plus diverses, dont la coopération n'est nulle part plus indispensable.

P. Masson-Oursel. (Paris.)

N. B. — Pour ne pas étendre à l'excès les dimensions de cette bibliographie, nous n'avons pas cru devoir en développer également toutes les parties. Ainsi, la considérable littérature bouddhique a été passée sous silence, car nous pouvions nous contenter de renvoyer sur ce point aux renseignements fournis par la *Buddhistische Litteratur* de Winternitz. Nous n'avons pas envisagé l'Inde anglaise contemporaine.

Abréviations :

B. E. F. E. O. Bulletin de l'Ecole française d'Extrême-Orient.
G. I. A. P. A. Grundriss der indo-arischen Philologie und Altertumskunde, Strassburg-Teubner.
J. A. Journal Asiatique.
S. B. E. Sacred Books of the East.
S. B. H. Sacred Books of the Hindus.

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I. Bibliographie générale

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T. II, ibid., 1861. Orient chrétien, Inde, Parsis, Indo-Chine et Malaisie, Chine, Japon, litt. mantchoue, mongole et tibétaine.

Ch. Friederici. Bibliotheca Orientalis, or a complete list of books, papers, serials and essays published in 1876 in England and the colonies, Germany and France on the history, languages, religions, antiquities and literature of the East.

II, 1877 ; III, 1878 (titre allemand désormais : oder eine vollständige Liste ...) ; ... VII, 1882 (double titre : all. et angl.) ; VIII, 1883.

[Ouvrage très consciencieux. Le dernier tome annonce, comme suite de l'entreprise, la publication suivante.]

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Aug. Müller, — puis Lucian Scherman Orientalische Bibliographie.

Le T. I, Berlin 1888, mentionne, sous la direction de Aug. Müller (Königsberg), la collaboration de Bezzenberger (Königsb.), Joh. Müller (Berl.), Strack (Berl.), Vollers (le Caire), Vijnmalen (La Haye).

Mit Unterstützung der Deut. Morg. Gesel.

T. XXIII-XXIV, 1909-1910, 1ᵉˢ Heft, Berlin 1912 [dernier n° paru], mentionne, sous la direction de L. Scherman, la collaboration de Barthold (St-Pétersb.), Fick (Berl.), Haas (N.-York), Katanov (Kazan), Moberg (Lund), Murad (Jaffa), Nützel (Berl.), Scherhring (Berl.), Thomas (London).

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K. L'INDE ET L'EUROPE MODERNE

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Essai sur la théorie de la connaissance dans la philosophie indienne (1).

Un des lieux communs que l'on répète le plus souvent à propos de la vie intellectuelle de l'Inde, c'est que les Indiens ont été des contemplateurs adonnés à l'extase mystique bien plus qu'à l'examen objectif, écoutant la voix d'une révélation intérieure plutôt qu'essayant d'analyser les faits de l'esprit et les phénomènes du monde extérieur. En peu de mots, le caractère prévalant de la philosophie indienne serait d'être surtout, et peut-être exclusivement, un ensemble d'hypothèses métaphysiques, qui seraient à la philosophie ce que la poésie est à la science.

Sans doute, cette opinion a en soi quelque chose de vrai : et si nous pouvons en expliquer l'origine et la diffusion par l'histoire des études d'indianisme, nous devons aussi admettre que la préoccupation métaphysique, je dirais même, l'idéal religieux ou tout au moins théïste ou théosophique, a joué un rôle assez grand dans le développement de la philosophie indienne. Cependant, il faut remarquer que la conception

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(1) Je prie les lecteurs de prendre le mot d' « essai » dans son sens le plus modeste : ce que je donne ici est une tentative, plutôt qu'une étude achevée et définitive. Je ne connais que trop bien toutes les difficultés qu'offrent des recherches de ce genre, pour prétendre d'avoir fait autre chose que d'esquisser quelques lignes d'une construction qu'on ne pourra achever que dans beaucoup d'années. Et j'insiste encore une fois sur deux faits qu'il ne faut jamais oublier lorsqu'on parle de philosophie indienne. L'étude des systèmes est bien loin d'être épuisée, et la variété des écoles d'un même système n'a peut-être pas été prise assez en considération. Deuxièmement, il faut examiner (et, ajoutons-le, réexaminer) tous les systèmes d'un point de vue plus méthodique, pour séparer les divers éléments qui s'y trouvent mélangés, en les recueillant et les discutant selon qu'ils se rattachent à la psychologie, à la logique, etc. J'ai déjà énoncé et soutenu ces principes de méthode dans mon *Introduzione allo studio della filosofia indiana* (Pavia, 1913) qui est la base de cet article, tant pour les idées directrices, que pour les faits documentaires.

de la philosophie comme une science est loin d'avoir été étrangère à l'Inde. Dès le IIIe siècle av. J.-C., nous trouvons cette idée exposée avec une netteté vigoureuse et simple à la fois : « La philosophie, dit KAUṬILYA (1), est jugée en tout cas comme une lumière pour toutes les sciences, une aide pour toutes les affaires, un soutien pour tous les devoirs. » Il serait difficile de caractériser d'une manière plus exacte et plus synthétique la fonction universelle de la philosophie et d'indiquer avec plus de concision son rôle, qui est de nous donner, au moyen de la réflexion — de « raisons », pour employer un mot de KAUṬILYA — des principes généraux qui expliquent et régissent notre activité intellectuelle et morale. En résumé, il n'y a aucune exagération à affirmer que, pour l'Inde aussi, la philosophie est une critique générale, une science des principes, dans le sens que nous donnons aujourd'hui à ces termes.

De tous les systèmes philosophiques de l'Inde, ceux qui possèdent au plus haut degré cette tendance à la recherche scientifique, sont le Nyâya et le Vaiçeshika, qui, dans le cours des siècles, sont allés toujours se rapprochant, jusqu'à ce qu'ils ont donné naissance, je ne dirai pas à un nouveau système, mais à un corps de doctrines qui, résultant des éléments communs aux deux écoles, ont fini par constituer une espèce de syllabus philosophique dont la connaissance s'imposait, non seulement à ceux qui voulaient aborder l'étude du Nyâya et du Vaiçeshika, mais à quiconque voulait s'initier aux études philosophiques en général. En effet, un des traits les plus saillants dans le développement de ces deux systèmes, c'est l'importance qu'y a assumée la théorie de la connaissance. Sans entrer ici dans la question de savoir si la critique des principes de psychologie et d'épistémologie a été commencée ou achevée par les Bouddhistes ou par les adhérents du Vaiçeshika, c'est un fait certain que la théorie qui en résulta s'est étendue aux autres systèmes, qui ont fini par l'admettre en l'adaptant au cadre de leurs doctrines particulières. Cette pénétration est allée si loin que, comme nous le disions tout à l'heure, l'étude de la philosophie commence, dans les écoles des pandits indiens, par ces traités qui, tout en étant des *summae* du Nyâya-Vaiçeshika, ont cependant le caractère de véritables manuels d'éléments ou d'institutions philosophiques.

C'est donc de ces traités que nous partirons dans notre exposé, en évitant dans la mesure du possible toute discussion doctrinale : les

(1) *Arthaçâstra*, p. 7.

opinions des divers systèmes seront énoncées seulement dans les cas plus importants.

Le sujet de la conscience et de la connaissance est l'âme, le moi, l'*âtman*, qui est le « support », le substrat (*âçraya*) des notions, ce qui revient à dire qu'il est le point central de la conception psychologique. Mais lorsqu'il s'agit de déterminer par quel moyen le Moi élabore les matériaux fournis par l'expérience, les différents systèmes, bien loin de s'accorder, montrent même une assez grande incertitude : l'on dirait qu'ils n'ont pas possédé bien clairement la notion dans le domaine physique, d'un organe central, le cerveau, et, dans le domaine psychologique, de cette faculté que nous appelons raison, et qui, par la perception et la pensée, est, pour ainsi dire, l'instrument abstrait de tous les actes intellectuels. L'on a voulu trouver quelque chose de semblable dans la *buddhi* du Nyâya-Vaiçeshika : mais ce terme signifie tout simplement « notion », « connaissance », et non « raison ». Plus rapprochée de notre conception moderne de « raison » est peut-être la *buddhi* du Sâmkhya. Mr. Garbe, en effet, traduit ce terme par « Verstand » : il faut cependant remarquer que le Sâṃkhya entend par *buddhi* quelque chose de matériel, « ein physiches Ingrediens des Organismus (1). » Cependant, le Nyâya-Vaiçeshika, comme tout système de philosophie qui veut avoir une base solide dans la réalité des faits, devait trouver ou imaginer cet organe central qui, en élaborant les données de l'expérience, produit et reproduit les représentations. Jusqu'à un certain point, cette double fonction est accomplie par le *manas*, ou « organe intérieur » (*antaḥkaraṇa*), qui est comme le trait d'union entre l'*âtman* ou Moi et le système des sens ou organes de relation.

La connaissance est une qualité de l'âme, et forme le contenu de la conscience. Selon le Nyâya, toute notion qui a une origine sensorielle passe par trois phases : contact entre l'organe et son objet, notion et conscience. Si nous avons devant nous, par exemple une fleur, notre organe de la vue vient en contact avec elle et rapporte l'image au *manas*, qui transmet cette image à l'âme. A ce point, l'image de l'objet se transforme en une notion, *buddhi*, qui peut s'exprimer par les mots « ceci est une fleur ». Mais la connaissance est une qualité de l'âme : par conséquent, dans le cas qui nous occupe, l'on dira que l'âme

(1) Garbe, *Die Sâṃkhya-Philosophie*, p. 244.

vient « fournie de la notion de la fleur » ; et puisque l'âme ou Moi est toujours accompagnée par la conscience de l'être, ces deux éléments — la notion et la conscience — se combinent pour donner naissance à ce stade du processus, que nous pouvons appeler la conscience de connaître, et que le sanscrit, en s'aidant de sa faculté presque illimitée de former des composés, exprime ainsi : « Je [suis] fourni-de-la-notion-de-la-fleur » (*pushpajnânavân aham*), ce qui revient à dire « je connais la fleur ». De cette manière, la notion « ceci est une fleur » devient le contenu de cet état de la conscience qui s'exprime par les mots « je connais ».

Les notions peuvent être vraies ou fausses, selon qu'elles correspondent ou ne correspondent pas à leur objet. Mieux encore, l'on appelle vraie cette notion dans laquelle la forme ou caractère de l'objet — c'est-à-dire de la chose considérée comme représentée — correspond aux caractères essentiels dont la chose est pourvue en réalité. Cela veut dire que, lorsque nous voyons une chose quelconque, par exemple une fleur, cette chose devient l'objet de notre notion, et le caractère particulier (*viçeshaṇa*) dont la chose est fournie et qui la fait être ce qu'elle est, devient la forme (*prakâra*) de la notion que nous avons de la chose. S'il y a correspondance entre le *viçeshaṇa* et le *prakâra*, c'est-à-dire, si les caractères de l'objet sont reproduits fidèlement et exactement dans la notion que nous avons de l'objet, cette notion sera vraie ; en tout cas contraire, elle sera fausse. Mais comment et pourquoi dit-on qu'une notion est vraie ? La question peut-être formulée aussi de cette manière : par quel moyen pouvons nous constater que l'objet, tel que nous nous le représentons, correspond à ce que l'objet est réellement ? Le problème a naturellement deux aspects, selon que nous considérons la vérité ou la fausseté possible de nos notions. Les réponses que les systèmes indiens ont données à la question peuvent se réduire à deux : la vérité ou la fausseté d'une notion se connaissent de soi-même, *svataḥ* (Sâṃkhya), ou bien par quelque chose de divers, *parataḥ* par une opération de contrôle (Nyâya). Les Bouddhistes et les Mîmâṃsakas se tiennent à moitié chemin entre ces deux théories opposées : les premiers croient que la fausseté d'une notion est évidente de soi-même, tandis que sa vérité a besoin d'être démontrée ; les Mîmâṃsakas au contraire affirment que la vérité de nos connaissances est intrinsèquement évidente, mais que l'on doit avoir recours à une preuve extérieure pour en démontrer la fausseté. Le noyau de la question se réduit donc à voir si nos connaissances sont vraies par force propre (théorie du *svatastva*) ou si leur

vérité résulte d'un contrôle ou d'une preuve différente de la notion (*paratastva*).

Les adhérents de la première théorie (*svatastva*) raisonnent de la manière suivante. Supposons qu'un homme ait soif et qu'il voit au loin de l'eau : aussitôt que son œil a vu et son Moi a connu que dans une certaine place il y a de l'eau, il y dirige ses pas. Peu importe si cette eau existe vraiment ou soit seulement l'effet d'un mirage : la notion qu'il en a eu, *en tant que notion*, est vraie, car elle a été la cause d'une action (*pravṛtti*), celle de se diriger vers le lieu ou cette eau a paru à ses yeux. En développant la théorie jusqu'à ces dernières conséquences, l'on devrait admettre qu'il n'y a pas de notions vraies et de notions fausses, mais bien que toutes sont vraies. C'est en effet ce que soutient une des écoles des Mîmâṃsakas, les Prâbhâkaras, qui ne font pas de différence entre les deux espèces de notions, en disant que toutes sont vraies parce que toutes produisent, dans le sujet connaissant, une action qui ne pourrait se vérifier si la notion n'était pas vraie pour le sujet. Les adhérents de l'autre théorie (*paratastva*) opposent qu'il ne suffit pas qu'une notion se traduise en action pour démontrer qu'elle est vraie, car il faut auparavant constater que l'objet existe réellement avec les caractères dont il se présente pourvu dans la notion que nous en avons. Car il est toujours possible, quand l'on perçoit un objet, de se demander si cet objet existe réellement et s'il a bien la forme qui lui est attribuée par notre connaissance. En d'autre mots, il faut un contrôle direct de la vérité matérielle ou un acte subsidiaire du raisonnement, souvent l'un et l'autre. Les deux théories, on le voit tout de suite, sont fondées sur deux tendances opposées : la première est idéaliste, la deuxième est réaliste. Dans cette discussion, nous devons voir un des épisodes du contraste de ces deux grands courants philosophiques qui se sont trouvés en présence dans la vie intellectuelle de l'Inde à un degré pour rien moindre que dans les autres pays de haute civilisation.

Nos connaissances peuvent se diviser en deux grandes catégories : représentations (*anubhava*) et souvenirs (*smṛti*). La représentation est une notion primitive, qui n'est ni la reproduction ni la répétition d'aucune notion antérieure. Au contraire, le souvenir est une notion secondaire et dérivée, produite par une impression. Une représentation, dès qu'elle est entrée dans le domaine de la connaissance, y reste imprimée grâce à une faculté qu'on nomme impression mentale (*bhâvanâ*) ou simplement impression (*saṃskâra*). Cette impression est considérée comme l'instrument, ou acte intermédiaire (*vyâpâra*),

entre la représentation et le souvenir : originée de la première, elle produit le second, et forme pour ainsi dire le trait d'union entre les deux. Il faut remarquer que le Nyâya-Vaiçeshika sépare bien nettement le souvenir (*smṛti*) et la reconnaissance (*pratyabhijñâ*). Le *criterium distinctionis* est ceci, que la perception manque dans le souvenir, tandis qu'elle agit dans la reconnaissance. Un texte (*Tarka-bhâshâ*, p. 86) dit : « l'impression, réveillée, produit le souvenir ». Dans la reconnaissance il s'agit, en conclusion, d'un procédé d'association, qui a sa base dans le fait de percevoir un objet qui a quelque rapport avec un autre objet déjà perçu. Le premier est appelé *udbobhaka*, « ce qui réveille » l'image d'un autre objet qui ne tombe plus sous nos sens quand la perception de l'autre le rappelle à notre esprit. Dans la reconnaissance, le procédé est divers : l'objet que nous reconnaissons tombe actuellement sous l'un ou l'autre de nos sens, et réveille en nous une notion identique que nous possédons déjà et qui se réveille dans sa plénitude par effet de l'impression déjà existante dans notre esprit et de la nouvelle perception. En résumé, nous pouvons dire, en employant les mots des textes, que la reconnaissance est une notion d'identité.

Les représentations, c'est-à-dire les notions primitives, originaires, peuvent se diviser en classes, selon la manière dont elles se produisent : par exemple, la notion qui dérive directement des impressions de nos organes des sens, est tout à fait différente de celle que nous obtenons par la voie d'un raisonnement. Ici, se pose naturellement la question de savoir *comment* se forme chaque notion (1), par quel procédé, par exemple, nous arrivons à avoir la perception d'un objet ou à formuler une conclusion logique. Les philosophes indiens répondent que chaque espèce de notion se produit par un moyen particulier : ainsi, la connaissance directe que nous avons d'un objet par nos sens, se produit par perception, tandis que nous arrivons à formuler une conclusion logique au moyen d'un procédé illatif. Toutes ces différentes manières dont se forment les notions diverses, reçoivent le nom générique de *pramâna*. Ce terme a besoin de quelques illustrations. Plusieurs auteurs le définissent en disant que « le moyen de connaissance est la cause de la notion », en entendant par notion seulement la notion vraie. Mais cette définition n'est

(1) Il faut remarquer que, ici et dans la suite, l'on entend par « notion » une notion vraie, *pramâ*, car les notions fausses sont des non-notions, *a-pramâ*.

pas complète : ce serait mieux de dire avec MADHAVA (¹) que l'on doit appeler moyen de connaissance « ce qui donne lieu à une notion vraie et n'est pas séparé ni des organes [qui concourent à la former] ni du siège même de la connaissance », c'est-à-dire du Moi. En effet dans toute notion nous avons le sujet qui connaît, l'objet qui doit être connu, et l'acte ou l'ensemble des actes par lesquels l'objet se reflète, pour ainsi dire, dans le Moi, sous forme de notion. Ainsi, il ne suffit pas de la présence du sujet connaissant ni de l'objet qu'on doit connaître, ni, non plus, des organes des sens : il faut que tous ces éléments entrent en relation l'un avec l'autre, par un moyen qui, par exemple dans la perception, sera le contact entre l'objet et l'organe particulier qui doit le percevoir : en effet, la vue, l'ouïe, le goût, etc., sont sans doute des instruments et, par conséquent, des moyens pour connaître les objets, mais, s'ils sont nécessaires, ils ne sont pas suffisants. Par « moyen de connaissance » nous devons donc entendre ce procédé — peut-être, ce moment du procédé — particulier à la formation de chaque notion, qui, en permettant au Moi d'exercer ses organes (les sens ou la raison) sur les objets, permet aussi d'arriver à une notion correcte. Ce sera, dans la perception, le contact entre les sens et les objets; dans le raisonnement, l'emploi d'un syllogisme conçu selon les règles rigoureuses de la logique.

Nous sommes ainsi en présence de deux séries de termes, où viennent se ranger naturellement, d'un côté, les notions, ou pour mieux dire, les différentes espèces de représentations, de l'autre, les moyens de connaissance. Il faut cependant remarquer tout de suite que les systèmes de philosophie indiens ne sont nullement d'accord sur ce point : la diversité dans le nombre des *pramâṇas* admis par l'un ou par l'autre d'entre eux, constitue même une des différences plus remarquables, qui a sa base dans la diversité des principes fondamentaux propres à chaque système. Ainsi, les matérialistes soutiennent que toutes nos connaissances dérivent exclusivement des sens, et par conséquent n'admettent d'autre *pramâṇa* que la perception. Les Vaiçeshikas et les Bouddhistes admettent la perception et l'illation. Les Jaïnas divisent la connaissance en directe et indirecte; la première comprend la perception, la seconde, l'illation et la parole : ce sont donc trois *pramâṇas* qu'ils admettent, ainsi que les Sâṃkhyas, les adhérents du Yoga et quelque école du Vedânta. Les Naiyâyikas

(¹) *Sarvadarçanasaṃgraha* (édition de Poona), p. 92.

admettent quatre moyens de connaissance : la perception, l'illation, l'analogie et la parole. Des autres systèmes ajoutent des autres *pramâṇas*, mais la plupart rentrent dans quelques uns de ceux que nous avons déjà énoncé : il suffit de mentionner l'évidence intuitive (*arthâpatti*) et la non-perception (*anupalabdhi*) qui sont admis par les Mîmâṃsakas et les Védantistes et qui servent de prétexte à des discussions fréquentes et assez intéressantes dans les textes des écoles rivales.

Ce n'est pas ici le lieu d'aborder une critique de ces classifications : il faudrait pour être fidèle à cet esprit d'objectivité qui doit présider à des exposés du genre de celui-ci, reproduire ou résumer des longues polémiques d'un intérêt souvent discutable. Nous nous bornerons donc à la perception, à l'illation et à la parole, qui, du point de vue le plus général de la mentalité indienne, sont les trois « moyens de connaissance » les mieux caractérisés et qui comprennent en soi les autres.

La perception (*pratyaksha*) est cette notion produite par les sens, ou, plus exactement, la notion produite par le contact d'un organe avec son objet. L'on comprend donc dans ce terme toutes les données de l'expérience directe, cette partie des représentations ou *anubhavas* qu'on pourrait appeller primitives. Cependant, les transformations que subissent les sensations pour se changer en perceptions, sont assez compliquées, et la théorie du Nyâya-Vaiçeshika sur ce point est assez intéressante pour mériter d'être résumée avec quelque ampleur.

Nos philosophes soutiennent qu'une perception peut être de deux espèces : *nirvikalpaka* et *savikalpaka*. J'ai reproduit les deux mots dans l'original sanscrit, parce qu'ils sont des plus difficiles à traduire par un seul terme de nos langues. L'on a proposé plusieurs traductions, qui sont toutes plus ou moins défectueuses (ce qui arrive bien souvent à propos de la terminologie philosophique indienne) : l'on pourrait, jusqu'à un certain point, y faire correspondre les deux termes « indéterminée » et « déterminée ». Ce sont ceux que j'ai choisis moi-même dans quelques-uns de mes travaux, mais, je le reconnais volontiers, je n'en suis pas satisfait : peut-être, serait-ce mieux de traduire *nirvikalpaka* par «synthétique» et *savikalpaka* par « analytique ». Mais ces deux termes de notre dictionnaire philosophique ont une extension qui ne coïncide pas parfaitement avec celle des termes sanscrits : le mieux, c'est encore d'exposer la théorie

indienne en employant les mots sanscrits ou les mots français selon les besoins didactiques du moment.

Lorsque nous voyons un objet quelconque, nous commençons par en avoir une notion vague, indéterminée, qui peut s'exprimer à peu près en disant que « nous voyons quelque chose », ou que « ceci est quelque chose » : nous connaissons que « ceci » est un objet, mais nous ne savons pas encore *ce* qu'il est ou *comment* il est. Au fur et à mesure que notre observation se précise, nous voyons tous les attributs de l'objet, qui se reflètent dans notre esprit, en y donnant origine à une notion où l'objet est reproduit avec tous les caractères dont il est pourvu en rélaité : nous avons alors une notion déterminée. La chose cependant n'est pas si simple qu'on pourrait le croire de prime abord. En effet, pour employer la terminologie indienne, la notion d'un objet présuppose la notion de sa forme : par exemple, je ne peux dire que « ceci est un cheval », si je ne sais pas en quoi consiste l' « être cheval » (*Pferdheit*, dirait-on en allemand). Par conséquent, dans une perception doivent se trouver deux éléments, la notion de l'objet en question et la notion de ses attributs ; et notre connaissance sera complète et déterminée lorsque nous pourrons établir un rapport entre ces deux éléments. C'est pourquoi quelques textes nous disent que la notion indéterminée est celle qui n'arrive pas jusqu'au rapport entre l'attribut et l'objet qui en est pourvu, tandis qu'on doit appeler déterminée la notion où ce rapport est perçu et connu. Il s'ensuit que la perception, dans sa forme complète, est la combinaison de deux éléments : c'est donc un acte complexe, et la notion qui en dérive peut être appelée, elle aussi, complexe, ce qui serait une autre manière de décrire, sinon de traduire, le terme sanscrit *savikalpaka*. Il s'agit, en effet, d'une composition, d'une synthèse (qui cependant — il faut le remarquer expressément — est précédée d'une analyse), de la sensation avec la notion des attributs de l'objet, notion qui doit être préexistante dans notre esprit, car il serait autrement impossible de dire ce qu'est un objet et de l'appeler par son nom. Le passage de la notion indéterminée, où nous avons la sensation brute de l'objet, à la notion déterminée, se fait donc au moyen d'un acte intermédiaire, d'un *avântara-vyâpâra*, comme le dit un texte (*Tarkabhâshâ*, p. 27-28). Toute perception doit passer par ces deux phases, et il faut admettre qu'une perception, même la plus rapide et la plus claire, commence par cette phase où il n'y a que la perception, nous dirions presque la sensation, grossière et indéterminée, qui nous fait connaître seulement qu'il y a un objet dont nos sens sont affectés. Ce premier moment,

qu'on pourrait appeler de synthèse informe et brute, parce que l'objet et ses attributs y sont compris sans que nous en connaissions le rapport, se soustrait à notre conscience.

Ici, se pose une question. Puisque la perception est une notion produite par les sens, l'on peut se demander quelle est, des deux espèces de perception, *nirvikalpaka* et *savikalpaka*, celle qui est vraiment produite par le contact de l'organe avec son objet. En effet, lorsque nous avons la notion complète de cet objet, de telle manière que nous le connaissons avec ses attributs, dans sa constitution et avec son nom, nous nous servons d'autres connaissances qui ont leur origine ou dans l'analogie, ou dans le raisonnement, ou dans quelque autre source de connaissance qui n'est pas seulement la perception des sens. Cette complexité constitutive de la notion « déterminée » devrait nous faire conclure qu'elle n'est pas le produit direct des sens, mais plutôt l'élaboration définitive des matériaux que les sens nous fournissent. L'on devrait par conséquent admettre que seulement la perception indéterminée se produit du contact des organes avec les objets sensibles, et qu'elle est vraiment « perception ». Mais la perception est une notion, et une notion doit reproduire l'objet avec tous les attributs qu'il possède en réalité. Or, nous savons que dans la perception « indéterminée » nous n'arrivons pas à connaître l'objet dans sa réalité, mais seulement à le sentir comme quelque chose qui entre en contact avec nos sens. Nous sommes donc en présence d'une alternative qui serait sans issue, si la théorie que nous avons exposée ne nous donnait la clef de l'énigme. La notion indéterminée est sensation, tandis que la notion déterminée est perception. L'ignorance des sciences naturelles n'a pas permis à nos philosophes de poser dès le début cette distinction, qui, en donnant une base expérimentale à leurs théories, leur eût épargné bien des tâtonnements et des discussions.

Dans sa plus simple expression, le procédé de la perception, selon les philosophes indiens, peut se décrire avec les mots de VÂTSYÂYANA [1] : « le Moi s'unit avec le sens intérieur (*manas*), celui-ci avec l'organe et l'organe avec son objet. » Nous avons donc une succession de trois « contacts » — l'on pourrait dire : moments —, et de quatre termes, succession qui doit établir comment le sujet entre en communication avec le monde extérieur. Les traits d'union entre les deux termes

(1) *Nyâyasûtrabhâshya*, I, 1, 4.

opposés de la chaîne sont le *manas* et les organes des sens. Ces derniers mots pourraient faire supposer que le *manas* est toute autre chose que les organes des sens. Cela est vrai et n'est pas vrai : et la confusion que, l'on serait tenté de voir dans la théorie que nous allons exposer, n'est peut-être autre chose que l'embarras que nous semblent avoir éprouvé des philosophes magnifiquement doués du point de vue spéculatif, mais raisonnants sans l'appui des sciences naturelles. L'on dirait que nos philosophes, arrivés par spéculation à l'extrême limite qui les séparait de la vérité, n'ont pas eu la force de franchir le dernier degré : c'est comme si leurs yeux, clairs et perçants, se fussent obscurcis juste au moment où ils allaient avoir la vision exacte des choses. Mais voyons ce qu'on doit entendre par organe des sens (*indriya*) et par *manas* et quel est, par conséquent, le nombre des organes.

En général, les idées des philosophes indiens sur ce point peuvent se résumer en disant qu'il y a six organes des sens, qu'on divise en deux groupes : 1° organe intérieur, ou *manas*; 2° organes extérieurs, qui sont les cinq organes de la vue, de l'ouïe, etc. Le *manas* est donc classé à part, tout en le considérant comme un organe des sens. Son rôle est double : d'une part, il sert de trait d'union entre les cinq organes extérieurs et le Moi, de l'autre, il est l'instrument qui sert à la perception du plaisir, de la douleur, et, en général, de ces sensations subjectives qui peuvent être exprimées par des phrases du type de celles-ci : « je suis heureux », « je suis malheureux ». En effet, entre ces sensations ou perceptions intérieures (nous employons expressément les deux mots parce que, même ici, les deux idées ne paraissent pas avoir été clairement distinguées par les philosophes indiens) et les perceptions qui nous viennent des organes des sens, il n'y a d'autre différence apparente que le sujet — nous dirions presque le sujet grammatical. Ainsi, puisque plaisir, douleur, etc., sont des qualités de l'âme, il faut supposer un sens pour les percevoir, de la même manière que les autres sens perçoivent les qualités des autres substances. D'autre part, le *manas* sert à mettre en rapport les organes extérieurs avec le Moi, en rendant ainsi possible la connaissance du monde des phénomènes : aucune perception ne peut avoir lieu, si le *manas* ne s'unit pas, d'une part avec l'*âtman*, de l'autre, avec les organes extérieurs. Nous serions tentés d'y voir quelque chose de semblable à un organe central, dont les fonctions seraient à peu près celles du cerveau, et quelques textes semblent appuyer cette impres-

sion. VÂTSYÂYANA (1) dit que le *manas* sert à nous faire connaître tous les objets parce que les sens, isolés, seraient insuffisants à les percevoir, ce qui, selon un autre texte (2), revient à dire que le *manas* est l'agent indirect (mais nécessaire) dans la production des notions relatives aux objets extérieurs, tandis qu'il est l'agent direct dans les notions des objets intérieurs. De cette manière, le *manas* est le véritable instrument, nous pourrions même dire, l'organe, de la pensée : cerveau et raison à la fois. Mais nos philosophes ne sont pas arrivés à cette conception qui nous semble évidente dans sa nécessité. Il faut cependant reconnaître qu'ils en ont eu l'intuition et que l'idée d'un organe ou d'un pouvoir central s'est présentée à leur esprit : l'ignorance des sciences biologiques et la tendance à la spéculation théorique les ont empêchés de donner à leur intuition une expression exacte et une base scientifique.

C'est ici que nous devons voir la cause de cet embarras et de cette incertitude dont nous parlions tout à l'heure, incertitude qui se révèle aussi dans les textes. GAUTAMA, le codificateur du Nyâya, fait du *manas* une des subdivisions du connaissable, en le distinguant des organes des sens (*indriya*), et les Mâyâvâdins nient qu'il soit un *indriya*, en se fondant sur l'Ecriture, qui le nomme séparément des organes des sens et le place au-dessus d'eux.

En laissant de côté le *manas*, dont la nature et les fonctions sont si complexes que même les philosophes indiens ne sont pas d'accord sur la place qu'on doit lui donner, il reste cinq organes sensoriels, ceux que l'observation même superficielle et primitive a permis à toutes les philosophies de prendre comme base physiologique de leur psychologie : les organes de la vue, de l'ouïe, du goût, de l'odorat et du toucher. Les données physiologiques essentielles de nos textes sur ce point peuvent se résumer de la manière suivante :

1° Sens de la vue. Il réside dans la pupille et a pour son organe l'œil : il sert à la perception de la couleur (*rûpa*) et de la lumière. Il y a six couleurs : blanc, bleu, jaune, vert, rouge et brun : quelques-uns ajoutent la couleur bariolée (*citrarûpa*), mais il s'agit sans doute d'une addition tardive, qui a donné lieu à beaucoup de discussions pour et contre, et qui est refusée par beaucoup de textes.

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(1) *Nyâyasûtrabhâshya*, I, 1, 9.

(2) *Nyâyasiddhântamañjarî*, citée dans *Nyâyakosha*, p. 590.

2° Sens de l'ouïe. Il a pour organe cette partie de l'éther qui est comprise dans la cavité auriculaire, et il sert à percevoir les sons. Le son — qui est une qualité de l'éther — peut être de deux espèces, articulé ou inarticulé : le premier se produit par les organes de la voix et prend la forme du langage ; le second comprend les bruits, et, en général, toute espèce de sons qui ne peuvent pas se formuler en mots. Il semble qu'il faille comprendre dans les bruits même la musique : au moins, je n'ai pas trouvé dans les textes des passages qui la traite à part. — La théorie physique du son, qui est considéré comme la qualité de l'éther, peut se résumer ainsi, en laissant de côté les distinctions et les discussions particulières. Il faut admettre que, selon la théorie du Nyâya, qui, plus ou moins modifiée, se retrouve dans d'autres systèmes de l'Inde, tout ce qui existe et, par conséquent, aussi les qualités, a son existence limitée tout au plus à trois moments : celui de sa production, celui de son existence, celui de sa destruction. Or, le son, qui est une qualité, passe par ces trois phases, qui sont momentanées : et puisque le son se produit loin de l'organe qui doit le percevoir, il s'en suivrait qu'il ne pourrait pas être perçu, la période de son existence étant trop courte, et son lieu d'origine trop éloigné de la cavité auriculaire pour permettre, dans le temps et dans l'espace, le contact avec l'organe de l'ouïe. Nos philosophes ont donc supposé que le son, aussitôt qu'il s'est produit dans un point de l'éther, donne origine à un autre son semblable dans la partie de l'éther immédiatement voisine ; ce deuxième son en produit un troisième, celui-ci un quatrième et ainsi de suite jusqu'au dernier son qui, se produisant dans la région de l'éther qui est comprise dans la cavité auriculaire, peut être perçue parce qu'il est en contact avec l'organe. Cette théorie physique, qui, on le voit facilement, a beaucoup d'analogie avec la théorie moderne des ondes sonores, est acceptée généralement dans la forme que nous venons d'exposer : seulement, quelques-uns admettent que les sons se propagent en ligne droite, se générant l'un de l'autre « comme les vagues de la mer », quelques autres, au contraire, soutiennent qu'ils se diffusent dans toutes les directions, « comme les filaments de Kadamba ».

3° Sens du goût. Il réside dans l'extrémité de la langue. Les sensations de goût peuvent être : le doux, l'aigre, l'âcre, le piquant, l'astringent et l'amer.

4° Sens de l'odorat. Il a pour organe le nez, et les odeurs peuvent être de deux espèces : agréables et désagréables.

5° Sens du toucher. Son organe est la peau et les sensations qu'il peut produire sont de trois espèces : le froid, le chaud et le tiède, ou chaleur tempérée. Il ne semble pas que nos textes aient approfondi l'analyse des sensations cutanées au delà des faits thermiques. Dans la littérature, nous trouvons aussi les noms de sensations tactiles proprement dites, par exemple le rugueux, le poli, etc. (1) ; mais toutes les variétés des sensations de la vie organiqne, des sensations musculaires, etc., ne semblent pas avoir attiré l'attention de nos philosophes.

Cet aperçu sommaire des données primitives des sens selon les philosophes indiens — plus particulièrement, selon les adhérents du Nyâya-Vaiçeshika — est assez conforme aux résultats de la psychologie moderne. Sans doute, dans quelques points, une connaissance plus approfondie ou une application plus constante des sciences physiques, eût permis une détermination plus exacte et plus rigoureuse des éléments primitifs de la sensation (2) ; mais nous devons reconnaître que, même aujourd'hui, nous ne sommes pas beaucoup plus avancés que les Indiens, car quand nous voulons classer ces données primitives des sens, nous devons souvent nous contenter de critériums tout à fait affectifs.

La théorie que nous venons d'exposer, et qu'on pourrait appeler la physique psychologique, est loin d'épuiser toute la matière que les philosophes indiens recueillent sous le titre de *pratyaksha*, de perception ou notion directe. Il nous faut donc étudier le mécanisme complexe du procédé psychologique, et voir quel est le jeu, si fin et si compliqué, qui nous permet d'élaborer les matériaux de l'expérience et d'acquérir la connaissance du monde extérieur.

Rappelons les mots de VÂTSYÂYANA cités plus haut : « le Moi s'unit avec le *manas*, celui-ci avec l'organe, et l'organe avec l'objet ». Le point de départ est donc le contact de l'organe avec l'objet, et nous devons voir quels sont ces objets et de quelle manière agit ce contact. L'ensemble de tout ce que nous pouvons connaître se range dans six (ou sept) catégories : substance, qualité, mouvement, généralité, particularité, inhérence (et négation). Toutes ces catégories ont comme

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(1) Voir la citation du *Mahâbhârata* dans *Nyâyakoça*[2], p. 958-959.

(2) Par exemple, ils auraient vu que l'astringence et l'âcreté ne doivent pas être classées entre les sensations du goût, mais comprises dans les sensations cutanées.

caractère commun d'être objet de connaissance; nous devons donc voir jusqu'à quel point et de quelle manière elles peuvent être connues directement et tomber dans le domaine du *pratyaksha*.

L'on distingue à ce propos six variétés de contacts :

1° conjonction (*saṃyoga*) ;

2° inhérence en ce qui est conjoint (*saṃyuktasamavâya*) ;

3° inhérence en ce qui inhère en ce qui est conjoint (*saṃyuktasamavetasamavâya*) ;

4° inhérence (*samavâya*) ;

5° inhérence en ce qui inhère (*samavetasamavâya*) ;

6° rapport entre sujet et prédicat (*viçeshaṇatâ*).

Cette terminologie et cette classification exigent une explication assez détaillée, surtout à cause des principes particuliers qui en forment la base. Lorsque nous voyons une fleur, il y a contact, conjonction (*saṃyoga*), entre l'œil et l'objet. Mais en percevant l'objet nous en percevons aussi la couleur : cependant l'œil, qui est substance, ne peut pas s'unir directement avec la qualité d'une autre substance; par conséquent, nous connaissons la couleur de la fleur parce qu'elle inhère dans la fleur, qui vient en contact avec l'œil. Encore : lorsque nous percevons dans un objet une qualité, nous avons aussi l'idée générique de cette qualité : par exemple, en voyant une fleur bleue, nous percevons aussi que ce « bleu » est une couleur. Or, cette généralité ne peut pas entrer en contact direct avec l'œil, qui, comme nous l'avons vu, ne peut même pas se mettre en contact avec les qualités; il s'ensuit que nous percevons la « généralité » de « couleur » parce qu'elle inhère dans la couleur spéciale (dans notre cas, le bleu) qui, elle aussi, inhère dans l'objet (la fleur) qui vient en contact avec l'organe de la vue. Dans la perception du son, nous avons un procédé différent. Nous savons que l'organe de l'ouïe est « cette partie de l'éther qui est limitée par la cavité auriculaire », et que le son inhère dans l'éther parce qu'il est sa qualité spécifique. Cela donné, l'on comprend que notre perception auditive a lieu parce que le son que nous percevons inhère dans cette partie de l'éther qui forme notre organe de l'ouïe : le contact est donc ici une inhérence (*samavâya*). Nous savons encore que la « généralité » inhère dans l'objet qui en est pourvu, c'est-à-dire que chaque unité d'une espèce se rattache à l'idée générale de l'espèce : ainsi, par exemple, lorsque nous connaissons que « ceci est bleu », nous sommes censés connaître aussi ce que c'est que la couleur. De la même manière, lorsque nous percevons un

son — un mot sanscrit ou une rumeur inarticulée quelconque — nous « percevons » aussi, c'est-à-dire nous connaissons, qu'il est un son, ce qui signifie, que nous percevons, non seulement le son particulier qui nous frappe dans ce moment, mais aussi qu'il est un individu de cette classe qu'on appelle « son » en général. Or, cette perception a lieu parce que la « généralité » — nous dirions l'idée abstraite et générique — d' « être son » inhère dans le son particulier qui, lui, inhère dans l'éther, qui forme notre organe de l'ouie. Nous avons ainsi le cinquième contact, qu'on appelle précisément « inhérence dans ce qui inhère » (*samavetasamavâya*).

Avant de continuer notre examen, il faut reprendre la question en la formulant de la manière suivante : quelles sont les catégories que nous pouvons percevoir avec nos sens? Les substances sont perçues par les yeux — les modernes disent par les yeux et par le toucher —, pourvu que leur couleur (et leur tangibilité) soient « manifestées », c'est-à-dire, pourvu que les substances puissent effectivement impressionner nos sens de la vue ou du toucher. Le contact est ici direct : l'organe s'unit avec son objet, et nous avons la première forme de *saṃnikarsha* (contact) qu'on nomme justement *saṃyoga*, union. Les qualités et le mouvement peuvent être perçus par tous les organes, au moyen du deuxième contact : en effet, ni les qualités ni le mouvement ne peuvent être perçus indépendamment de l'objet qui en est pourvu, parce qu'ils n'existent pas isolés : par définition, ils inhèrent dans les substances. La catégorie de « généralité » peut se percevoir par la deuxième ou la troisième variété de contact, selon qu'il s'agit de l'idée générale de substance ou de celle de qualité ou de mouvement. La quatrième catégorie n'est pas susceptible de perception directe : en effet, la particularité réside dans les atomes et ne peut pas être connue au moyen de nos sens. Restent donc les deux autres catégories, inhérence et négation, qui sont perçues par le sixième contact, qu'on nomme « rapport entre sujet et prédicat ». Cependant, selon les Vaiçeshikas, l'inhérence ne peut pas être connue directement par les sens, mais seulement déduite par la voie d'un raisonnement : nous nous bornerons donc à étudier ce sixième contact dans ses rapports avec la catégorie de négation. La question n'est nullement oisive : elle a son importance bien marquée dans l'histoire des systèmes de philosophie indiens et sert très bien comme exemple de la subtilité de méthode du Nyâya.

La négation, qui est, des sept catégories du Vaiçeshika, celle qui a été retrouvée après les autres, est, pour ainsi dire, la contre-partie

des catégories positives, et représente en quelque sorte l'idée du non-être, opposée aux différentes manières d'être qui ont leurs expressions dans les six premières catégories. Cependant, ce non-être, est : l'on dirait que l'idée négative est conçue en forme positive; par conséquent l'on croit que le non-être peut être perçu directement par un contact des sens avec l'objet. Mais la négation est, à tous points de vue, différente des autres catégories, et nous ne pouvons pas la percevoir par aucun des cinq contacts examinés jusqu'ici et qui se réduisent à l'union et à l'inhérence et à leurs combinaisons. Par conséquent, pour expliquer la perception directe de la négation, l'on a recours à cette espèce particulière de contact qu'on nomme *viçeshaṇatâ* ou *viçeshaṇaviçeshyabhâva*, rapport de sujet à prédicat ou rapport entre le qualifié et la qualification. Supposons que nous ayons sous les yeux un espace de terrain vide : nous pouvons dire que le sol est pourvu de la non-existence, par exemple, d'un pot (*ghaṭa*), ce que le sanscrit exprime avec un substantif et un adjectif composé, *bhûtalam* (le sol) *ghaṭa-abhâva-vat*. Dans cette phrase, la non-existence du pot est la qualification (*viçeshaṇa*) du sol, qui est le terme qualifié (*viçeshya*) : or, tandis que le sol, qui est substance, est perçu directement par l'œil qui s'unit immédiatement avec lui, la non-existence au contraire peut entrer en contact avec l'œil et être perçue seulement parce qu'elle est une qualification du sol. Ce rapport de qualification est donc ce qui nous permet de connaître la négation par le moyen des sens, et nous pouvons l'envisager de deux points de vue différents, selon que nous faisons sujet de la phrase la négation de la chose donnée, ou le lieu où se vérifie cette négation. Il en dérive deux notions et deux expressions différentes : « le sol est pourvu de la non-existence du pot » (*bhûtalam ghâṭâbhâvavat*,) ou bien « ici sur le sol il y a la non-existence du pot » (*iha bhûtale ghâṭâbhâvaḥ*).

Cette théorie n'a pas été acceptée sans contraste par les autres écoles philosophiques de l'Inde. Les Mîmâṃsakas la rejettent, en la démolissant par des critiques auxquelles les auteurs de Nyâya répondent avec beaucoup de subtilité. Les discussions, souvent fatigantes, qui en sont dérivées, ne méritent pas d'être résumées ici. Il suffit de remarquer que les Mîmâṃsakas nient tout le procédé admis par les Naiyâyikas, et soutiennent qu'on connaît la non-existence d'un objet parce que nous ne le percevons pas, et ils ajoutent aux autres *pramâṇas* celui de la non-perception (*anupalabdhi*), dont la fonction est justement de faire connaître l'*abhâva*. En tout cas, la catégorie de la non-existence a été introduite plus tard dans le Vaiçeshika, dont elle

a été assumée par le Nyâya-Vaiçeshika dans la période du syncrétisme : nous pouvons nous passer d'insister plus longtemps sur cette question qui, au fond, n'est pas essentielle.

Le lecteur qui aura eu la patience de nous suivre jusqu'ici aura sans doute remarqué que nos philosophes comprennent sous le nom de *pratyaksha* une grande partie de ce que nous appelons aujourd'hui psychologie. Cette analogie (qu'il faut naturellement entendre avec beaucoup de discrétion) paraît encore plus évidente par ce qui suit. Les faits que nous avons exposé dans les pages précédentes regardent, selon le Nyâya-Vaiçeshika, les connaissances que nous obtenons au moyen de nos sens, qui, d'une manière ou d'une autre, entrent en contact avec les objets : c'est donc une perception normale, commune, ordinaire — *laukika*, comme disent les textes. Cependant, il y a toute une série de faits qui ressortent, pour nous, du domaine de la psychologie, et, pour nos auteurs, de celui du *pratyaksha*, sans qu'on puisse parler, pour eux, d'une origine spécifiquement sensorielle. Ces faits forment ce que les textes appellent perception extraordinaire (*alaukikaṃ pratyakskam*), et se produisent, eux aussi, par un contact, mais un contact tout à fait *sui generis*, qu'on appela *pratyâsatti*. Il s'agit d'une perception ultrasensible, mais qui est toujours perception. Elle comprend trois variétés, dont la dernière ne nous intéresse pas, parce qu'elle est propre aux ascètes et se rattache à des idées mystiques et théosophiques dont même les systèmes réalistes de l'Inde n'ont su se dépouiller. Nous bornerons notre examen aux deux autres variétés, qui ont une valeur vraiment philosophique. Supposons de voir un objet : en le percevant par nos sens, nous connaissons aussi sa « généralité », son *sâmânya*, ou concept comme disent les Indiens, son espèce, comme nous dirions. Il s'ensuit que la perception d'un objet réveille en nous l'idée de l'espèce à laquelle cet objet appartient, et cette idée d'espèce rappelle, en quelque sorte, à notre esprit tous les autres individus qui forment l'espèce, de telle manière que la perception de cet indivi du x nous procure la perception complexe de tous les autres individus qui, avec celui-ci, forment l'espèce. Le trait d'union entre les deux « perceptions » est l'idée d'espèce, avec laquelle, selon nos auteurs, s'unit le *manas*, au moyen d'un contact qui n'est pas sensible et qui donne naissance à une perception qu'on appelle *sâmânyalakshaṇa*, « caractérisée par la généralité ». Supposons à présent qu'une fleur tombe sous nos sens de manière à ne pas les affecter tous à la fois : par exemple, qu'elle soit si éloignée de nous, que nous pouvions la voir sans cependant en percevoir le parfum. Or,

lorsque nous la voyons, nous disons, non seulement « ceci est une fleur », mais aussi « cette fleur est parfumée ». La perception du parfum ne peut pas se produire par les yeux, qui ne perçoivent pas les odeurs, ni par le sens de l'odorat, parce que l'objet est trop éloigné pour qu'il soit possible d'en recueillir le parfum : il est donc nécessaire d'admettre que la perception olfactive concomitante à la perception visuelle est causée par la notion, préalablement acquise, de l'odeur propre à cette fleur. Donc, quand en percevant effectivement une qualité d'un objet, nous en percevons aussi une autre qui cependant ne tombe pas sous le domaine du sens qui devrait la faire connaître, nous opérons par une notion intermédiaire : d'où le nom, donné à ce procédé, de *jnânalakshaṇa*, « caractérisé par une notion ». Il est évident que, dans les deux cas examinés tout à l'heure, nous sommes en présence de véritables faits d'association. Nos philosophes ont parfaitement compris que ces faits sont causés par une perception, et ils les ont rangés dans le *pratyaksha*; mais ils ont compris aussi que le contact des organes sensoriels avec les objets n'en est pas le facteur essentiel et suffisant, et c'est pourquoi ils ont imaginé un contact *sui generis*, qui surpasse la portée commune des organes et est ultrasensible.

Notre exposé des théories psychologiques des Indiens ne serait pas complet si nous ne disions pas quelque chose du sommeil et du rêve. Rappelons encore une fois que la connaissance et la conscience ont leur origine dans le contact entre le Moi et le monde extérieur par le moyen du *manas* et des organes des sens. Nous devons à présent ajouter que l'*âtman* est omniprésent : par conséquent, il devrait se trouver partout où se trouve le *manas*, ce qui signifie que la chaîne de contacts *âtman* — *manas* — organes — objets ne serait jamais interrompue et le sommeil serait impossible. Cependant, il était impossible de nier le fait. L'on a donc eu recours à une conception dont on ne saurait dire si elle est physique ou biologique, celle du *puritat*. Dans la région voisine du cœur il y aurait une veine, appelée de ce nom, où le *manas*, qui est de sa nature atomique, entrerait pendant le sommeil, en interrompant ainsi les rapports entre l'*âtman* et le monde extérieur. Le sommeil a deux gradations, qu'on appelle *nidrâ* et *sushupti* : leur différence peut se décrire en disant que dans la *sushupti* il y a le détachement le plus complet du *manas* des organes et du Moi, de manière que toute conscience est comme abolie, tandis que dans la *nidrâ* se font encore sentir les impressions de l'état de veille. Nous pourrions traduire *sushupti* par « sommeil sans rêves », qui est aussi

l'expression populaire pour indiquer le sommeil profond et complet. Déjà dans cette distraction il y a les premiers éléments d'une théorie du rêve, c'est-à-dire d'un phénomène qui a bien des traits en commun avec le phénomène du souvenir. KAṆÂDA dit en effet (1) : « le souvenir se produit d'un contact particulier entre le Moi et le *manas*, et de l'impression ». Et il ajoute de l'aphorisme suivant « de la même manière se produit le rêve ». L'on admet donc que l'origine des rêves consiste essentiellement dans la persistance d'impressions qui se transforment en images par effet de l'organe central, tant l'activité inconsciente se continue pendant le sommeil. Deux auteurs, PRAÇASTAPÂDA et ÇANKARA MIÇRA, à la distance d'au moins huit siècles l'un de l'autre, analysent, presque avec les mêmes mots, les causes qui peuvent donner naissance aux rêves. Elles se réduisent à trois catégories, que nous appellerons, d'après leur nature, physique, psychologique et métaphysique. Les causes physiques sont représentées par les troubles des humeurs du corps humain. Les causes psychologiques se réduisent, au fond, à des mouvements passionnels ou à des impressions qui, après s'être produites dans l'état de veille, persistent pendant le sommeil. Les causes métaphysiques consistent dans le mérite et le démérite que chaque être humain a accumulés dans ses migrations à travers le *saṃsâra* : chaque âme individuelle est accompagnée dans son voyage indéfini à travers l'océan des existences, par le même *manas*, qui est censé conserver les impressions, je dirai presque les empreintes, de ce qu'il a perçu dans le cours de ses renaissances.

Nous avons ainsi dessiné, dans ses grandes lignes, ce qu'on serait tenté d'appeller la psychologie indienne. Cependant, nous ne voulons pas employer ce terme de « psychologie », qui a une portée et une acception trop modernes. Les philosophes de l'Inde ont divisé le domaine des connaissances humaines selon un principe plus schématique et, jusqu'à un certain point, empirique, d'après les moyens qui nous permettent d'acquérir les diverses notions. Pour appliquer aux systèmes indiens les divisions de notre encyclopédie philosophique, nous devrions révolutionner la méthode des textes originaux, ce que je ne trouve pas convenable. Car dans une exposition comme celle-ci, qui veut donner en peu de pages un aperçu fidèle des théories indiennes de la connaissance, l'on doit pousser la fidélité jusqu'à reproduire,

(1) *Vaiçeshikadarçana*, IX, 2, 6.

autant qu'il est possible, l'ordre suivant lequel la matière est disposée dans les textes. Et l'ordre signifie, non la forme, mais la méthode.

Le terme qui exprime le deuxième moyen de connaissance, *anumâna* ou raisonnement, a, comme le terme de *pratyaksha*, une portée bien plus large qu'on ne pourrait supposer en le traduisant plus ou moins à la lettre. Dans le fait, il sert à indiquer tout l'ensemble de la logique, dans son double aspect de science de principes et de science formelle. Il ne rentre pas dans notre plan d'exposer tout au long la théorie minutieuse du syllogisme, la technique du raisonnement, ses règles et la classification de ses erreurs : nous nous bornerons à donner un aperçu des principes théoriques, en un mot, nous traiterons ici l'élément psychologique de la logique indienne. Il est inutile de remarquer que la distinction entre les deux parties de cette science ne sera pas toujours absolue : car il est difficile de nettement séparer ce qui dans le fait est bien souvent inséparable.

Selon la définition plus commune, l'on entend par *anumâna* la cause spécifique de la conclusion logique (*anumiti*). La conclusion se produit par un acte de notre esprit qu'on appelle *parâmarça* — (un terme bien difficile à traduire et sur lequel nous reviendrons tout à l'heure) — et qui « consiste dans la notion que la raison est l'attribut du sujet et se trouve dans un rapport de concomitance avec la conséquence »[1]. Si nous voyons *une chose*, par exemple une montagne avec le sommet couronné de fumée, nous sommes tout naturellement portés à en tirer la *conséquence* qu'elle doit avoir du feu, par la *raison* que la fumée se trouve seulement là où il y a du feu. Nous avons ici un acte complexe, dans lequel la raison (au terme moyen) se présente à notre esprit comme attribut de la chose, ou sujet, et comme constamment unie avec la conséquence. Ce n'est pas le syllogisme, ce n'est pas la conclusion, ni le raisonnement dans sa forme achevée : c'est plutôt la phase qui suit la perception et précède la conclusion, le stade où tous les éléments essentiels de l'acte logique se présentent à notre esprit d'une manière synthétique. Le processus du raisonnement peut se résumer ainsi, en paraphrasant et presque en traduisant les mots d'un texte (*Tarkabhâshâ*, p. 35-36). Si nous voyons plusieurs fois, par exemple dans une cuisine, la fumée et le feu, nous sommes portés à établir, par effet de cette vision réitérée, une concomitance constante

(1) *Tarkasaṃgraha*, p. 44.

entre le feu et la fumée, concomitance qui est inhérente à la nature même des deux termes et que nous exprimons en disant « partout où il y a de la fumée, il y a aussi du feu ». L'on a ici la première phase du procédé illatif, qui résulte de deux éléments : l'un sensoriel, consistant dans la perception réitérée du fait, l'autre intellectuel, consistant dans la notion perceptive de la concomitance invariable entre la fumée et le feu. La deuxième phase consiste dans la notion que dans une chose, par exemple la montagne, se trouve de la fumée. Alors, nous nous rappelons que les données expérimentales nous ont permis d'établir la concomitance entre la fumée et le feu, et, en appliquant cette constatation au cas particulier, et en réfléchissant sur le fait que dans le mont se trouve l'attribut d'être pourvu de la fumée, nous disons : « sur *cette* montagne se trouve la fumée qui est toujours accompagnée par le feu ». Nous atteignons ici une nouvelle phase, où se trouvent réunies les deux notions que dans cette montagne se trouve la fumée, et que la fumée est toujours accompagnée par le feu. C'est la troisième phase, qui consiste dans une « réflexion » sur la marque caractéristique » (*linga-parâmarça*) : on pourra l'appeller, comme l'a déjà appellée M. Jacobi [1], la représentation de la conclusion, car elle contient tous les éléments qui devront nous faire aboutir à la conclusion formulée dans les mots « donc cette montagne a du feu ».

Dans le passage de la *Tarkabhâshâ* que nous venons de paraphraser, sont contenues les données essentielles de la théorie logique. Pour qu'un raisonnement soit possible, il faut appliquer au cas particulier un principe général établi sur l'expérience. Cette application se fait en constatant que dans la chose se trouve un attribut ou signe caractéristique — *linga* — que nous savons toujours concomitant avec un autre qu'on doit démontrer existant aussi dans la chose. Ces deux éléments — existence du « signe », ou moyen terme, dans la chose (*paksha*), et rapport de concomitance entre le moyen terme et la conséquence — sont au même degré nécessaires et doivent se combiner ensemble. En effet, si nous nous bornions simplement à remarquer qu'une chose est pourvue d'un attribut quelconque, ou à énoncer simplement le rapport de concomitance, nous ne pourrions jamais aboutir à une conclusion, car nous aurions seulement, dans le premier cas, la constatation d'un fait, dans le deuxième, l'affirmation d'un principe général. Il faut donc que les deux notions — l'une sensorielle et

(1) *Die indische Logik* (dans *Nachrichten d. K. Ges. d. Wiss. zu Göttingen*, Philol.-hist. klasse, 1901, p. 460-484).

l'autre théorique — se combinent ensemble, d'une manière précise, par un rapport de sujet à prédicat, ainsi : « cette montagne a-du-feu-qui-est-toujours-accompagné-par-la-fumée », *vahnivyâpyadhûmavân ayaṃ parvataḥ*. Cette expression est intéressante pour deux raisons. En premier lieu, elle nous montre que les deux éléments dont nous parlions tout à l'heure sont considérés en rapport au terme moyen, qui doit donc se trouver dans la chose et être en concomitance constante avec la conséquence, ce qui nous explique pourquoi l'on fait consister l'acte du raisonnement dans une « réflexion sur la marque, ou moyen terme » (*linga-parâmarça*). Deuxièmement, elle nous permet de voir de quelle manière nos philosophes envisageaient le procédé illatif : pour eux — et dans la réalité — nous avons avant tout la perception d'un fait, par exemple, que dans un sujet x se trouve un certain attribut, et seulement après cette perception se réveille en nous la notion du principe général que cet attribut est toujours accompagné par un autre qui, par conséquent, doit se trouver aussi dans le sujet, mais qui se présente de premier abord à notre esprit comme une propriété, non du sujet, mais du terme moyen considéré dans le sujet : ainsi, dans l'exemple donné, le feu qui doit se trouver dans la montagne, nous apparaît comme l'attribut de la fumée que nous voyons sur la montagne. De cette conception qui répond à la succession naturelle des moments du procédé logique, en partant de la perception pour arriver à la conclusion, dérive la forme que le sillogisme a assumée dans le Nyâya-Vaiçeshika : nous y reviendrons dans les pages suivantes.

Dans tout syllogisme, nous opérons sur trois éléments : la chose ou sujet (*paksha*); la raison (*hetu*) ou marque caractéristique (*linga*) ou moyen de démonstration (*sâdhana*); et la conséquence (*sâdhya*) : ce sont les trois termes, grand, petit et moyen de notre logique. La fonction du moyen terme, dans la logique indienne, est naturellement la même que dans toute logique et nous ne saurions mieux la décrire qu'en reproduisant les mots de Taine (*Intelligence*, II, 391). « Entre les deux données qui font couple, il s'en trouve une autre intermédiaire qui, étant liée d'une part à la première et d'autre part à la seconde, provoque par sa présence la liaison de la seconde et de la première; en sorte que cette dernière liaison est dérivée et présuppose comme conditions les deux liaisons préalables. » Le fondement vraiment essentiel, le point central de tout raisonnement consiste donc dans la notion d'un rapport de concomitance nécessaire et constant de deux termes, de manière que, étant donnée l'existence de l'un, il s'ensuit

forcément l'existence de l'autre. Ce rapport, qui prend dans le fait la forme d'un principe général, est appelé par les Indiens *vyâpti*.

Par concomitance ou *vyâpti* l'on doit entendre, selon les définitions des textes, « un rapport inhérent à la nature même des deux termes concomitants » [1] : ce qu'on explique en disant que « la concomitance consiste dans le fait que la raison a invariablement le même substrat que la conséquence » [2] : en d'autres mots, que, où il y a la raison, il y a aussi la conséquence. Cette conception de la *vyâpti* comprend donc deux éléments : celui de la coexistence des deux termes et celui de l'invariabilité de cette coexistence : ça revient à dire que la liaison est nécessaire et universelle parce qu'elle se vérifie dans tous les cas identiques. En appliquant ces observations au syllogisme nous dirons que la concomitance contient la raison, qui est toujours accompagnée par la conséquence, et la conséquence, qui accompagne toujours la raison : l'on appelle la première *vyâpya* et la seconde *vyâpaka* [3]. Il faut cependant se garder d'interpréter la concomitance comme impliquant une idée d'extension : plutôt, elle est fondée sur l'idée de coexistence. S'il y a (pour nous servir d'un exemple heureusement choisi par Athalye) [4] vingt personnes, dont cinq possèdent cent rupies et les quinze autres, cinquante, nous dirons que le nombre cinquante est le *vyâpaka* et le nombre cent le *vyâpya*, parce que le cinquante se trouve dans tous les vingt cas, tandis que le cent se trouve dans cinq seulement; l'on peut donc dire que le cinquante coexiste avec le cent, mais il serait faux de dire l'inverse, que le cent coexiste avec le cinquante. Il s'ensuit que le *vyâpaka*, ou conséquence, doit être plus grand ou tout au moins l'égal du *vyâpya*, mais jamais plus petit, en se rappellant toujours que « grand » et « petit » indique ici, non l'extension des deux termes, mais le nombre des cas où les deux termes se présentent unis.

Le fondement du raisonnement est la perception : comme les sensations constituent les éléments primitifs de la perception, ainsi les perceptions sont les éléments primitifs du raisonnement. C'est toujours l'expérience qui nous fournit les matériaux de notre activité psychologique. Les textes, en commentant des *sûtras* de Gautama [5], nous

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(1) *Tarkabhâshâ*, p. 35.
(2) *Tarkakaumudî*, p 11.
(3) Cf. Jacobi, *Ind. Log.*, p. 462.
(4) *Tarkasaṃgraha*, p 246.
(5) *Nyâyadarçana*, I, 1, 5.

disent que le raisonnement présuppose la perception. Ce sont nos sens qui, après nous avoir appris, par des perceptions réitérées et uniformes, que la fumée et le feu sont concomitants, nous permettent de généraliser cette expérience dans un principe constant et nécessaire; ce sont aussi nos sens, qui, en percevant dans un nouveau cas un des termes du rapport, réveillent en nous le souvenir de ce rapport. L'on peut cependant se poser une question : c'est vrai que la concomitance a été établie après un nombre très grand d'observations expérimentales qui ont toutes démontré qu'elle se vérifie avec ses caractères de constance et de nécessité; mais l'on n'a pas épuisé tout le nombre des expériences possibles. Il n'est donc pas exclu *a priori* que dans quelques cas, soit même dans un cas, la concomitance vienne à manquer. En d'autres termes : comment peut-on démontrer que le principe *général* déduit d'une série indéfinie de cas particuliers, a une valeur *universelle?* Nos textes répondent qu'il suffit « que la notion de la concomitance soit accompagnée de l'absence de la notion d'un cas contraire » (1). Ça veut dire que, pour démontrer la réalité du rapport de concomitance, il suffit de démontrer l'impossibilité qu'il ne soit pas, c'est-à-dire que, ne pouvant pas contrôler tous les cas innombrables où se vérifie ce rapport, il suffit de prouver que le contraire de ce rapport (nous devrions dire de ce principe) porterait à des conséquences absurdes. C'est ce qu'on obtient au moyen d'une *reductio ad absurdum*, ou *tarka*, qui est décrite comme une notion fausse qu'on suppose vraie pour démontrer la vérité de la notion contraire.

L'on a vu que la concomitance a une valeur universelle, et que cette universalité est établie à l'aide d'une généralisation : c'est, en dernière analyse, un processus qui va du particulier au général. Cependant, nos auteurs n'ont recours, pour expliquer l'origine de l'idée de concomitance, ni à l'induction ni à l'abstraction, mais plutôt à la perception. En développant les données des textes, la question peut être exposée de la manière suivante. Soient a et b les deux termes de la concomitance. Nous avons vu, dans un nombre n de cas, que a et b sont concomitants, c'est-à-dire, nous connaissons directement un nombre n de a concomitants avec un nombre n de b; l'on aurait par conséquent le droit d'affirmer seulement que a^n et b^n sont concomitants, mais non que *tout a* et *tout b* sont concomitants. Pour que la concomitance ait vraiment la portée d'un principe universel et nécessaire,

(1) *Tarkasaṃgrahadīpikā*, p. 38 (§ 45).

il faut que dans notre esprit l'idée des deux classes d'objets *a* et *b* se substitue à la série d'individus *a* et *b* que nous connaissons ou avons connu par l'expérience; en d'autres mots, la concomitance doit être fondée sur l'idée de genre. C'est ce qui a lieu en effet, et c'est aussi ce qu'admettent nos philosophes; seulement, ils nient que l'idée de genre se produise par abstraction ou par inférence, mais affirment au contraire qu'elle dérive d'une « perception extraordinaire », d'un contact *sui generis* entre l'organe et l'objet, qu'on appelle *pratyâsatti*. Nous en avons déjà parlé plus haut : ici, nous ajouterons quelques mots nécessaires pour montrer comment on applique au raisonnement le procédé psychologique étudié à propos de la perception. L'idée de genre est inhérente à chaque objet qui rentre dans le genre, et par conséquent est appris directement par l'organe qui perçoit l'objet (1). Lorsque nous percevons par exemple *un* feu, soit dans une cuisine, soit dans une montagne ou dans n'importe quel lieu, nous avons aussi la perception d'ensemble de tous les feux; je dirai presque que la notion synthétique du genre « feu » est réapprise ou revue dans l'ensemble de ses éléments individuels chaque fois qu'on perçoit un des individus qui la constituent. S'il s'agit de deux termes concomitants — par exemple la fumée et le feu — la perception actuelle d'*une* fumée rappelle à l'esprit, non seulement l'idée collective de toutes les fumées dont résulte le genre « fumée », mais aussi l'idée collective de tous les feux qui forment le genre « feu », et nous avons ainsi la représentation de la concomitance entre *la* fumée et *le* feu. Ce procédé est ultra-sensoriel, mais il est, selon nos philosophes, toujours perception : nous dirions qu'il contient l'analyse psychologique du procédé logique Remarquons enfin que dans cette succession d'actes intellectuels l'induction a une place remarquable; seulement, les philosophes indiens n'ont pas fait du raisonnement inductif une variété à part de la connaissance.

Un des traits les plus remarquables de la théorie logique des Indiens, est celui de concevoir le rapport de concomitance d'une manière catégorique et de ne pas reconnaître la validité d'arguments conditionnés. Un auteur ancien, Çivâditya, finit sa définition de la *vyâpti* en disant qu'elle doit être exempte de conditions (*upâdhi*) (2). L'on entend par condition — *upâdhi* — un élément qui rend possible

(1) Cf. *Tarkabhâshâ*, p. 31.
(2) *Saptapadârthî*, § 149.

la conséquence seulement dans les cas où il est présent : il s'ensuit que la « condition » accompagne toujours la conséquence mais non la raison. Le rapport de concomitance n'est plus constant, parce qu'il admet des exceptions (*vyabhicâra*), et le raisonnement ne peut plus aboutir à une conclusion sûre et nécessaire. Ainsi, c'est vrai que « partout où il y a de la fumée il y a du feu »; mais l'inverse n'est pas vrai, notamment, que « partout où il y a du feu il y a de la fumée », parce que le feu, pour être fumant, doit être produit par des matériaux humides, et nous savons que, par exemple, les charbons incandescents brûlent sans fumer. Cependant, il semble que nos philosophes aient en quelque sorte admis la validité du rapport de concomitance conditionné, car ils ne sont pas d'accord à considérer erroné un terme moyen fondé sur une concomitance conditionnée.

Nous avons vu que le rapport de concomitance se base sur l'expérience. Lorsque nous voulons l'appliquer à un sujet (*paksha*), nous nous rappellerons tous les cas semblables (*sapaksha*) où ce rapport a déjà été constaté, de sorte qu'à la représentation de la concomitance s'accompagne le souvenir des cas analogues, et nous pensons tout naturellement : « dans cette montagne il y a de la fumée qui est toujours accompagnée par le feu, par exemple, dans une cuisine, etc. » Mais nous savons aussi que, où il n'y a pas de feu, ne peut pas y avoir de fumée : nous avons pu le constater en observant un fleuve, un lac, un étang, etc. Tous ces cas où nous sommes sûrs qu'il est impossible de rencontrer l'un des deux termes du rapport parce que l'existence de l'autre en est absolument exclue, s'appellent « cas ou exemples contraires » (*vipaksha*). Par conséquent, pour démontrer que dans un lieu quelconque il doit y avoir du feu parce qu'il y a de la fumée, nous pouvons nous servir de la concomitance positive (*anvaya*) « partout où il y a de la fumée, il y a du feu », ou de la concomitance négative (*vyatireka*) « partout où il n'y a pas de feu, il n'y a pas de fumée ». Pour les deux formes d'expression, nous pouvons aussi ajouter des exemples, qui seront pour la première, analogues, pour la seconde, contraires, au cas en question. Il arrive cependant qu'il soit possible d'avoir seulement l'une ou l'autre des deux formes de concomitance : l'on aura alors une concomitance purement positive (*kevalânvaya*) ou purement négative (*kevalavyatireka*). A ce propos, il faut faire quelques remarques. Considérées en soi, comme expressions d'un principe général, les deux concomitances purement positive et purement négative sont parfaitement justes et raisonnables. Mais quand on les prend pour base d'un syllogisme, l'on pourrait observer qu'elles

donnent lieu à un procédé mental qui n'appartient plus au domaine de la logique. La critique a été faite déjà par des écoles indiennes, par exemple, les Mîmâṃsakas et les Védantistes, qui ont combattu et nié surtout la concomitance purement négative. En effet, dans un syllogisme fondé sur celle-ci, il n'y a pas en réalité de terme moyen, parce que le sujet et la conséquence ont la même extension; ou, s'il y en a un, il coïncide avec les deux autres termes. Dans ce cas, il s'agit donc, non d'un raisonnement logique, mais d'une évidence intuitive (*arthâpatti*), d'une vérité axiomatique.

Nous avons exposé jusqu'ici les phases du raisonnement et étudié ses différents facteurs qui doivent aboutir à la conclusion logique (*anumiti*). Ces facteurs sont tous nécessaires; mais, puisqu'ils sont nombreux, on se pose la question de savoir lequel d'entre eux est la cause efficiente, spécifique, de la conclusion, ce qui revient à se demander en quoi consiste essentiellement l'opération du raisonnement. La réponse dépend de la définition qu'on donne de « cause efficiente » (*karaṇa*). « Dem Sprachgebrauch zufolge — dit M. Jacobi (1) — ist *karaṇa* soviel wie Instrument, und daher lautet eine Definition von *karaṇa* : eine thätige (*vyâpâravat*) Ursache (*kâraṇa*) heisst wirkende Ursache (*karaṇa*) : sie ist also eine specielle Ursache, welche durch eine mit ihr verknüpfte Aktion oder Funktion (*vyâpâra*) das Produkt erzeugt. » En appliquant cette définition au raisonnement, la cause efficiente serait la notion de la concomitance, et sa fonction le *parâmarça* ou « Schlussvorstellung », comme dit M. Jacobi (2). Quelques autres soutiennent que l'élément essentiel du raisonnement est la raison, connue comme existante dans le sujet et comme un des deux termes de la concomitance. D'autres enfin entendent par cause efficiente celle qui est toujours suivie par son effet. « Danach ist nicht das Instrument selbst, sondern dessen Aktion die wirkende Ursache. » Par conséquent, la cause efficiente de la conclusion logique serait le *parâmarça*. « Diese Ansicht — remarque très bien M. Jacobi (3) — empfahl sich um so mehr, als der Schluss nichts materielles wie ein Instrument ist und darum nicht wohl der Träger einer Aktion sein kann. »

Un raisonnement illatif, une inférence ou *anumâna*, peut être de

(1) *Ind. Log.*, p. 467.
(2) Voir Jadadîça, *Tarkâmṛta*, p. 17.
(3) *Ibidem*, p. 468.

deux espèces : pour soi (*svârtha*) et pour autrui (*parârtha*). La première est celle que nous avons décrit dans les pages qui précèdent, et consiste dans un ensemble d'actes successifs de notre intelligence, qui nous conduisent à la conclusion. L'autre, est ce même procédé, limité non plus au sujet connaissant, mais exposé, selon un ordre donné, dans un schème rigoureux, pour faire naître dans une autre personne cette conviction raisonnée qui, pour nous, n'a plus aucun besoin de démonstration. L'inférence pour autrui présuppose naturellement celle pour soi, car il est impossible d'enseigner ce dont on n'a pas acquis la connaissance. Dans le *svârthânumâna* l'exposition en forme de syllogisme n'est pas nécessaire, parce que le sujet connaissant met immédiatement en relation les données de fait avec les notions qu'il possède déjà, et il arrive de soi-même à la conclusion, sans besoin de formuler systématiquement toutes les phases d'un procédé dont il a, dans le fait, conscience après coup. Au contraire, si nous voulons démontrer quelque chose à une autre personne, nous devons lui exposer dans leurs détails essentiels et dans leur succession logique les faits et les idées qui peuvent le conduire à la conclusion : il faut par conséquent employer une forme discursive (*vâkya*) : Praçastapâda (p. 231) dit que « l'inférence pour autrui consiste dans la démonstration, au moyen d'un discours (*vâkya*) divisé en cinq membres, de ce qui, pour nous, est déjà démontré ». La différence entre les deux espèces d'inférence se réduit, selon Dharmottara, a ceci, que l'inférence pour soi est « notionelle » (*jñânâtmaka*) et celle pour autrui est verbale (*çabdâtmaka*) [1]. L'observation est parfaitement vraie, et elle revient à dire que le nom d'inférence (*anumâna*) devait s'appliquer proprement à la première : l'autre indique seulement le moyen d'exprimer par des mots le processus intellectuel du raisonnement.

L'illation pour autrui comprend cinq membres (*anvaya*) :

1° Proposition (*pratijñâ*), qui contient le sujet avec la conséquence qu'on doit démontrer; par exemple : « dans la montagne il y a du feu »;

2° Raison (*hetu*, *linga*, *sâdhana*), où l'on exprime la caractéristique logique (*linga*) du sujet : elle donne la raison (*hetu*) de l'affirmation contenue dans la proposition et sert de moyen pour démontrer

(1) Cf. *Nyâyabindutikâ*, p. 21.

(*sâdhana*) la conséquence; par exemple : « parce qu'il y a de la fumée »;

3° L'exemple (*udâharaṇa*), qui contient l'énoncé de la concomitance, avec les cas analogues; par exemple : « partout où il y a de la fumée, il y a du feu; par exemple : dans une cuisine, etc. »;

4° L'application (*upanaya*) : elle sert à exprimer que le sujet a comme son propre attribut la marque logique qui est concomitante avec la conséquence; par exemple : « ainsi est cette montagne » — c'est-à-dire, pourvue de fumée qui accompagne toujours le feu;

5° Conclusion (*nigamana*), où l'on répète comme démontré ce que dans le premier membre l'on avait posé comme sujet de la discussion ; par exemple « par conséquent ainsi est ceci » — c'est-à-dire la montagne a du feu.

Ce schème fait voir que le syllogisme « pour autrui » a un but essentiellement didactique, et on pourrait aussi bien le décrire comme étant l'abrégé d'une petite discussion entre le maître et l'élève. L'on commence par poser la question, par énoncer ce qu'on veut démontrer : « le mont a du feu ». Celui qui entend, demande naturellement « pourquoi ? ». Et l'on répond « parce qu'il a de la fumée ». Cependant, cette réponse ne suffit pas, car l'on peut demander encore comment se fait-il qu'ayant de la fumée il doive avoir du feu. Il faut donc énoncer le principe général, où les deux termes sont mis dans un rapport de coexistence constante et nécessaire, et y ajouter ces autres exemples de cas semblables qui, étant connus, donnent au principe général la force d'un argument sûr et indiscutable. L'on a ainsi le troisième membre. A ce point, il ne reste plus qu'à appliquer le principe général au cas particulier, et à en tirer la conclusion, ce qui a lieu dans les deux derniers membres.

Si nous réfléchissons un moment sur les trois premiers membres de ce schème syllogistique (*nyâya*), nous ne pouvons pas nous soustraire à l'impression que l'énoncé de la concomitance dans le troisième y paraît comme déplacée et presque en contradiction avec l'empreinte empirique ou tout au moins réaliste de l'ensemble. Nous serions portés à trouver plus naturel qu'on eût dit : « ce mont a du feu parce qu'il a de la fumée, comme c'est le cas dans une cuisine, etc. ». En effet, ainsi a été à l'origine la forme des trois membres en question, comme l'a démontré Athalye [1] : seulement plus tard l'on

[1] *Tarkasaṃgraha* p. 279.

a ajouté l'énoncé théorique du rapport de concomitance. L'on voit ici que le syllogisme indien était, dans sa forme primitive, fondé sur l'analogie : la raison tirait sa force démonstrative du fait que l'on pouvait citer des cas, semblables ou dissemblables à celui en question, où elle se présente ou ne se présente pas avec la conséquence : ressemblance et dissemblance (*sâdharmya* et *vaidharmya*) étaient donc les deux critériums de base pour arriver à une connaissance que les organes sensoriels ne suffisent pas à nous donner ; en dernière analyse, ils se réduisent au principe de l'analogie, considérée des deux points de vue positif et négatif.

Les éléments dont résulte le procédé du raisonnement subjectif (*svârthânumâna* se reflètent naturellement dans le syllogisme formel, dont la partie essentielle, du point de vue théorique, est par conséquent le troisième membre, ou, peut-être mieux, le deuxième et le troisième, où l'on énonce le principe de concomitance et où l'on affirme qu'un des termes de cette concomitance se trouve, comme signe logique, dans le sujet. Il pourrait donc sembler inutile d'insister de nouveau sur cet argument. Mais la conception du rapport de concomitance tel que nous l'avons exposé plus haut, est le résultat d'une évolution assez longue des théories logiques dans l'Inde. Fondée comme elle est sur l'idée de coexistance, avec son caractère de nécessité et d'universalité, elle comprend en soi toutes les espèces possibles de rapports ; et c'est justement parce qu'elle se présente dans une forme synthétique et abstraite (en employant ce dernier mot avec les limitations que, nous l'avons vu, nous imposent les autres principes du Nyâya-Vaigeshika), que nous devons la considérer comme le produit d'une analyse ayant duré plusieurs siècles. En d'autres mots : avant d'arriver à concevoir dans une forme si compréhensive le rapport de concomitance, l'on a dû examiner quelles étaient, *in rerum natura*, les variétés possibles des rapports entre les choses. Étant donnée la tendance empirique ou tout au moins réaliste qui a déterminé les débats de l'art logique, c'est naturel qu'on ait commencé par chercher ces rapports dans la pratique de l'expérience, et que, ne pouvant pas encore séparer nettement le procédé mental de son expression verbale, l'on ait attribué au syllogisme une classification qui appartient au raisonnement : c'est le cas de Gautama, qui nous représente le stade le plus ancien de la logique indienne.

Nous sommes donc en présence d'une évolution dont il est intéressant de fixer les phases successives. En laissant de côté la forme achevée que nous avons étudié plus haut, nous pouvons distinguer

quatre étapes principales, qui sont représentées par GAUTAMA, KAṆÂDA, PRAÇASTAPÂDA et les BOUDDHISTES (1). GAUTAMA divise l'inférence en trois espèces : *pûrvavat*, *çeshavat* et *sâmânyato dṛshta*. Ces trois expressions sont assez difficiles à traduire, et c'est aussi difficile de préciser au juste ce qu'elles signifient. VÂTSYÂYANA les commente de deux manières différentes. M. JACOBI doute que les explications du commentateur répondent à la pensée de GAUTAMA, « denn es lässt sich... wahrscheinlich machen, dass GAUTAMA unter *pûrvavat* den Schluss von dem Späteren auf das Frühere, unter *çeshavat* den vom Früheren auf das Spätere verstanden habe ». Quant au *sâmânyato dṛshta*, ce serait, comme il le dit en employant les mots de BÜRK, « der Schluss auf etwas nicht sinnlich Wahrnehmbares, nur in abstracto zu Erkennendes ». KAṆÂDA recherche quels rapports réels entre les choses déterminent le rapport logique entre la raison et la conséquence, et il trouve qu'on peut les réduire aux quatre suivants : rapport de causalité, de connexion, de contradiction et d'inhérence. PRAÇASTAPADA introduit le concept de concomitance, divise l'inférence dans les deux variétés de *svârtha* et *parârtha* : la première représente pour lui le véritable procédé du raisonnement. Au lieu des trois subdivisions de GAUTAMA, il en admet seulement deux : *dṛshta* et *sâmânyato dṛshta*, « jenes ist der Schluss, wenn Sache und Beispiel nicht heterogen sind; dieses der Schluss kraft des Folge und Grund gemeinsamen Begriffes, wenn Sache und Beispiel absolut heterogen sind » (2). Enfin, les BOUDDHISTES réduisent, classifient le moyen terme sur la base des trois idées d'identité, de causalité et de négation.

La perception et le raisonnement, s'ils représentent en théorie les deux moyens par lesquels nos notions sont produites, n'épuisent pas toutes les modalités pratiques de la connaissance. En laissant de côté ces procédés qu'un examen même superficiel peut réduire à la perception ou au raisonnement ou démontrer qu'ils résultent de l'une et de l'autre combinés ensemble, il en reste un qui, par son caractère tout

(1) Voir, pour la discussion qui va suivre, l'article déjà cité de JACOBI, p. 476 et suiv., BÜRK, « Die Theorie d. Schlussfolgerung nach der Sâṃkhyatattvakaumudî des Vâcaspatimiçra » (dans *Wiener Zeitschr. für die Kunde des Morgenlandes*, vol. XV); TH. DE STCHERBATSKOI, Rapports entre la théorie bouddhique de la connaissance et l'enseignement des autres écoles philosophiques de l'Inde (*Muséon*, 1904, p. 129-171), et le chap. XVI de la deuxième partie de mon *Introduzione*, où toute la question est résumée et discutée.

(2) JACOBI, *loc. cit.* p. 481.

à fait particulier et par son inséparabilité de tous les actes de la pensée, semble se confondre avec eux. Nous devrions donc étudier à présent les théories des philosophes indiens regardant le langage. Mais nous devons résoudre une question préalable, qui est en partie une question de terminologie. Le moyen de connaissance dont nous allons nous occuper est appelé *çabda*. Le mot, à la lettre, signifie « son »; dans le fait, les savants européens qui ont étudié les textes philosophiques de l'Inde, l'ont traduit de façons très diverses : « Sprache » (Hultzsch), « Mitteilung » (Deussen), « zuverlässige Mitteilung » (Garbe), « word » (Müller). Le mieux, c'est peut-être de le rendre par « parole », c'est le mot que j'ai moi-même choisi dans d'autres travaux, parce qu'il peut comprendre en soi plusieurs significations différentes. En effet, le terme *çabda* vient à exprimer le langage articulé, l'enseignement d'un maître digne de foi, et même l'Écriture En conclusion, nous trouvons encore une fois, groupées sous un terme générique, plusieurs idées qui, jusqu'à un certain point, se ressemblent et se tiennent par un enchaînement logique, mais qui ne sont pas identiques. Probablement, le mot avait à l'origine une signification bien précise, qui a gagné en extension et en variété avec l'évolution de l'idée originaire qu'il exprimait.

Le sens des définitions que les textes donnent de *çabda* tient dans peu de mots : *âptavacanam* (ou *âptopadeçaḥ*), *çabdaḥ* : « La parole est le discours (*vacana*) ou l'enseignement (*upadeça*) d'une personne digne de foi (*âpta*) ». L'on entend par *âpta* celui qui dit la vérité, c'est-à-dire un homme qui expose les choses telles qu'elles sont réellement. Comme le dit R. Garbe [1], le *çabda* « ist urprunglich gewiss nichts anderes gewesen, als die Unterweisung von Seiten eines competenten Lehrers » ; mais cet enseignement tirait son autorité de sa vérité, et ne semble pas avoir eu le caractère dogmatique d'un *ipse dixit*. Et puisque tout enseignement s'exprime par des mots, l'on passa assez naturellement à étudier les éléments du langage, la manière dont ils se combinent ensemble et les rapports entre les mots et leurs significations. Les théories qui se sont ainsi formées touchent par bien des points aux théories rhétoriques et grammaticales, ce qui était naturel dans un pays où ces dernières ont eu un développement très remarquable. Nous nous bornerons cependant au côté philosophique de la question, en l'exposant selon la forme que le Nyâya lui a donné.

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(1) *Sâṃkhya-Philosophie*, p. 154.

Une définition du mot dit : « le mot (*pada*) est un ensemble de sons articulés, en entendant par « ensemble » (*samûha*) ce qui est l'objet d'une seule notion ». Cela veut dire que ce n'est pas de chaque son isolé d'un mot, mais de tous les sons dans leur ensemble, que se produit la notion de l'objet exprimé par le mot. Pour bien comprendre la définition il faut se rappeler la théorie de la momentanéité du son. Nous avons vu plus haut que tout son ne dure que trois moments, ou, pour mieux dire, que son existence est bornée à une triple phase momentanée, en tant qu'il se produit, qu'il est perçu et qu'il s'éteint. Par conséquent, lorsque nous prononçons un mot, nous faisons entendre une série de sons dont les premiers sont déjà éteints quand nous arrivons à articuler les derniers. Il s'ensuit que dans la perception d'un mot il faut distinguer deux éléments : la perception du dernier son et l'impression produite par les sons précédents. A ce point, nous connaissons, ou pour mieux dire, nous reconnaissons le mot, car tout ce procédé ressemble beaucoup à celui de la reconnaissance (*vratyabhijñâ*). D'une manière analogue se produit l'intelligence d'une phrase : l'organe de l'ouïe perçoit directement le dernier mot, dont le sens se combine avec celui des mots précédents au moyen des impressions réveillées par l'audition des mots précédents (1).

Mais quelle est la valeur idéologique du mot et quelle est au juste l'extension de son pouvoir d'expression? La question peut aussi être formulée de cette manière: un mot sert-il à désigner seulement un individu, ou tous les individus qu'on peut appeler par ce mot (idée de classe ou genre) ou les deux choses ensemble? (2) Les Mimâṃsakas soutiennent qu'un mot n'exprime que l'idée du genre; l'école moderne du Nyâya, que chaque mot désigne seulement un objet déterminé; l'école ancienne de Nyâya, qu'un mot indique l'individu et la classe à laquelle l'individu appartient; les Bouddhistes affirment qu'un mot sert uniquement à distinguer un objet de tout ce qui n'est pas l'objet.

Soit, par exemple, la phrase *ghaṭam ânaya* (3). Celui qui l'énonce

(1) Cf. *Tarkabhâshâ* p. 49. 50.

(2) Pour ce qui va suivre, voir ATHALYE, *Tarkasamgraha*, notes, p. 339-342, DVIVEDI, *Tarkakaumudî*, notes, p. 62 et le résumé de la discussion dans mon *Introduzione*, p. 436-438. Cf. aussi M. MÜLLER, *Six systems*, p. 530 et suiv.

(3) « Apporte (-moi) le pot. » C'est l'exemple qui, avec la monotonie propre aux Indiens en pareille matière, recourt dans presque tout les textes. Je l'ai conservé dans mon exposé, surtout parce qu'en le traduisant j'aurais dû employer l'article défini ou indéfini, qui aurait introduit dans la discussion une nuance qui est étrangère aux textes.

veut naturellement qu'on l'entende par rapport à un objet déterminé, car autrement il serait impossible que celui qui écoute pût jamais trouver ce qu'on demande. Par conséquent l'école moderne du Nyâya soutient qu'un mot indique un objet individuel parce que seulement dans ce cas cet objet peut devenir le but d'une action quelconque. Mais cette opinion aboutirait à la conséquence qu'il devrait y avoir autant de mots qu'il y a d'individus, tandis que dans le fait, il existe un seul mot pour désigner tous les individus qui ont en soi les traits caractéristiques de l'idée qui se présente en eux comme concrétisée. L'on comprend donc que l'école ancienne du Nyâya soutienne que chaque mot sert à la fois à exprimer l'idée et l'individu. Les Mîmâṃsaka vont plus loin dans la voie de l'abstraction, en affirmant qu'un mot exprime seulement l'idée, et que sous cette idée se rangent les individus: ils sont plus proches de notre conception moderne. Les Bouddhistes ont élaboré une théorie qui est la conséquence directe de l'application rigoureuse de leurs principes philosophiques. Nous ne pouvons pas connaître les choses dans leur réalité, et il nous est aussi impossible d'admettre l'idée générique de classe, parce qu'elle n'est qu'une conception subjective que nous imposons, non aux choses, mais à ce que nous croyons être les choses. Par conséquent, la fonction d'un mot est tout simplement d'exprimer qu'un objet a certains caractères qui le distinguent des autres. Les Védantistes soutiennent qu'un mot exprime, en soi, l'idée abstraite de la chose, tandis que « its capability of signifying the class-notion is derived from its aknowledged connection with the concrete objects comprised in that class » (1).

En poursuivant cette analyse des mots, des rapports entre leur forme verbale et leur signification, etc., les philosophes indiens ont abouti à une philosophie du langage qui est très intéressante, mais qui ne rentre pas dans le plan de cet article. Je dois aussi ajouter que, pour l'exposer avec l'ampleur nécessaire, il faudrait, non seulement étudier de ce point de vue particulier les textes des différentes écoles, mais exploiter aussi les traités de grammaire et de rhétorique: et peut-être le temps n'est pas encore arrivé pour un essai de ce genre. J'ai cru bon cependant de donner ici ces éléments qui se rattachent en quelque sorte à la théorie de la connaissance et qui rentrent, au fond, dans le domaine de la psychologie. En effet, ceux-ci sont les

(1) Athalye, *loc. cit.*, p. 342.

points qui nous intéressent, étant donné le but de cet article : car la parole, en tant qu'enseignement, rentre dans le *pratyaksha* ou dans l'*anumâna*, tandis que, considérée comme la révélation d'une vérité dogmatique, elle est matière de foi. Sans doute, il serait important de l'étudier de ce point de vue ; mais il ne semble pas que les philosophes indiens aient recherché les bases psychologiques de la croyance.

L. SUALI.

Pavia, 15 juillet 1914.

Did Fermat have a solution of the so-called Pellian equation?

In what follows, I have endeavoured to give a solution of the so-called Pellian equation, without employing continued fractions; there is nothing new in the results obtained, but it may prove interesting in connection with the query which forms the title of the article. FERMAT proposed three cases of this equation, as a challenge, through Sir KENELM DIGBY, to WALLIS, BROUNCKER and other English mathematicians; and he is reported to have stated that he had a general proof of the possibility of the equation being solved in integers in all cases where N is not a perfect square. Most authorities, in ascribing the complete solution to LAGRANGE and EULER, more especially to EULER, seem to me to hint that FERMAT did not, nay, could not have had a complete or even semi-complete proof : even when they do not state so explicitly. Their reason seems to be that such a proof is not possible without the employment of the method of continued fractions, and that FERMAT had no knowledge, or insufficient knowledge, of continued fractions. Now, FERMAT may have had sufficient knowledge of the theory of continued fractions for his purpose, although I am unaware that he published anything in which they are explicitly mentioned. But such an omission, in the case of FERMAT, proves nothing. We know that about the time of the correspondence between FERMAT and the English mathematicians the subject of continued fractions was being investigated ; for, in his *Arithmetica Infinitorum*, WALLIS gives the rules for forming successive convergents, in an appendix dealing with BROUNCKER's transformation of WALLIS's well-known infinite fraction for the value of $4/\pi$ into a continued fraction; so that BROUNCKER also must have being using them. However, FERMAT's work seemed to me to be essentially off these lines; and I endeavoured, without the employment of continued fractions, to

obtain a general solution of the equation, which would give at the same time a proof that a solution could always be found, and explain a statement made by FERMAT that he had a rule by means of which he could always tell whether an equation of the form $x^2 - Ny^2 = a$ had a solution in integers or not; when I had found one, I endeavoured so to arrange it that it would suggest naturally the process of discovery. Of course, I have had a working knowledge of the theory of continued fractions to assist me; but so may FERMAT have had. But I found that the method and the proof came out quite naturally without this knowledge, and in a manner suggestive of a Fermatian bit of work. There is some merit in the proof itself from a mathematical teacher's point of view; for, it is much shorter and easier to understand and work than the usual proof and process given in text-books on higher algebra. Further, it is self-contained, and is possible without any great knowledge of algebra. Indeed, beyond the rationalization of the denominator of a fraction, there is hardly anything in it to be dignified by the name of algebra.

It is clear that the values of x and y must be the numerator and denominator of a fraction that approximates closely to the value of $\sqrt{N}$.

Suppose we have two such fractions

$$\frac{x_{2n}}{y_{2n}} > \sqrt{N}, \text{ and } \frac{x_{2n+1}}{y_{2n+1}} < \sqrt{N};$$

then a closer approximation can be found in the following way.

Form the sequence of fractions

$$\frac{x_{2n}}{y_{2n}}, \quad \frac{x_{2n+1} + x_{2n}}{y_{2n+1} + y_{2n}}, \quad \frac{2x_{2n+1} + x_{2n}}{2x_{2n+1} + y_{2n}} \ldots\ldots, \quad \frac{x_{2n+1}}{y_{2n+1}}.$$

These fractions will be in descending order throughout if

$$\frac{\lambda x_{2n+1} + x_{2n}}{\lambda y_{2n+1} + y_{2n}} > \frac{(\lambda+1)\, x_{2n+1} + x_{2n}}{(\lambda+1)\, y_{2n+1} + y_{2n}}$$

for all values of λ from 0 to ∞ ; that is to say, if their difference

$$\frac{x_{2n}y_{2n+1} - x_{2n+1}y_{2n}}{[\lambda y_{2n+1} + y_{2n}]\ [(\lambda+1)\, y_{2n+1} + y_{2n}]}$$

is positive.

Suppose $\sqrt{N}$ lies between the two fractions given for the values λ and $\lambda + 1$; then it differs from either of them by something less

than the difference between the two fractions. The approximatiou will be the closest possible, for denominators that are not greater than those given, if the numerator of this difference is made as small as possible; *i. e.*, if we can take our values in all cases such that

$$x_{2n}y_{2n+1} - x_{2n+1}y_{2n} = 1.$$

Thus, to obtain a nearer approximation, x_{2n+2}/y_{2n+2}, which shall be greater than $\sqrt{N}$, but nearer to $\sqrt{N}$ than x_{2n}/y_{2n}, we take $x_{2n+2} = \lambda_{2n+1}.x_{2n+1} + x_{2n}$, $y_{2n+2} = \lambda_{2n+2}.y_{2n+2} + y_{2n}$.

It is clear that

$$x_{2n+2}.y_{2n+1} - x_{2n+1}.y_{2n+2} = 1 \text{ also.}$$

The correct value of λ_{2n+1} is found from the consideration that it is the greatest integer that will make

$$\lambda_{2n+1}.x_{2n+1} + x_{2n} > \sqrt{N.(\lambda_{2n+1}.y_{2n+1} + y_{2n})};$$

i. e., λ_{2n+1} is the greatest integer in

$$\frac{x_{2n} - \sqrt{N.y_{2n}}}{\sqrt{N.y_{2n+1}} - x_{2n+1}}$$

Similarly, we can find x_{2n+3}/y_{2n+3}, less than $\sqrt{N}$, but nearer to $\sqrt{N}$ than x_{2n+1}/y_{2n+1}, by taking

$$x_{2n+3} = \lambda_{2n+2}.x_{2n+2} + x_{2n+1}, \quad y_{2n+3} = \lambda_{2n+2}.y_{2n+2} + y_{2n+1},$$

where λ_{2n+2} is the greatest integer in

$$\frac{\sqrt{N.y_{2n+1}} - x_{2n+1}}{x_{2n+2} - \sqrt{N.y_{2n+2}}}.$$

Here again it is clear that

$$x_{2n+2}.y_{2n+3} - x_{2n+3}.y_{2n+2} = 1.$$

Proceeding in this way we obtain a sequence of fractions, alternately greater and less than $\sqrt{N}$, which continuously approximate more closely to the value of $\sqrt{N}$. Also there are no closer approximations, without increasing the denominator of the fraction, than any one of these fractions.

We thus have a series of equations, formed from the obvious solutions $1^2 - N.0^2 = 1$, and $x_1^2 - N.1^2 = -p_1$, which are to be identified with the first two of the system:

$$\begin{array}{llll}
x_0^2 - N.y_0^2 = 1 & , & \ldots\ldots & = \ldots \\
x_1^2 - N.y_1^2 = -p_1, & & x_{2n-1}^2 - N.y_{2n-1} & = -p_{2n-1}, \\
x_2^2 - N.y_2^2 = +p_2, & & x_{2n}^2 - N.y_{2n}^2 & = +p_{2n}, \\
x_3^2 - N.y_3^2 = -p_3, & & x_{2n+1}^2 - N.y_{2n+1}^2 & = -p_{2n+1}, \\
\ldots\ldots & & \ldots\ldots & = \ldots
\end{array}$$

together with the general equations

$$x_{2n} \cdot y_{2n-1} - x_{2n-1} \cdot y_{2n} = 1, \qquad x_{2n} \cdot y_{2n+1} - x_{2n+1} \cdot y_{2n} = 1,$$

which practically include the general equations

$$x_{r+1} = \lambda_r \cdot x_r + x_{r-1}, \text{ and } y_{r+1} = \lambda_r \cdot y_r + y_{r-1}.$$

Take any two consecutive equations of the first set and equate the products of corresponding members :

$$\begin{aligned} e.g., \quad -p_r\, p_{r+1} &= (x_r^2 - \mathrm{N}.\, y_r^2)\,(x_{r+1}^2 - \mathrm{N}.\, y_{r+1}^2) \\ &= (x_r x_{r+1} - \mathrm{N}.\, y_r y_{r+1})^2 - \mathrm{N}.\,(x_r y_{r+1} - x_{r+1} y_r)^2 ; \end{aligned}$$

hence $\mathrm{N} - p_r p_{r+1}$ is always a perfect square for all values of r, and

$$x_r x_{r+1} - \mathrm{N}.\, y_r y_{r+1} = \pm \sqrt{\mathrm{N} - p_r p_{r+1}},$$

where the ambiguity in sign remains to be determined.

Now, the fraction $\dfrac{\sqrt{\mathrm{N}.\, y_{2n-1}} - x_{2n-1}}{x_{2n} - \sqrt{\mathrm{N}}.\, y_{2n}}$ becomes, on rationalizing the denominator,

$$\frac{\sqrt{\mathrm{N}.(x_{2n} y_{2n-1}} - x_{2n-1} y_{2n}) - (x_{2n} x_{2n-1} - \mathrm{N}.\, y_{2n} y_{2n-1})}{x_{2n}^2 - \mathrm{N}\, y_{2n}^2}$$

or

$$(\sqrt{\mathrm{N}} \pm \sqrt{\mathrm{N} - v_{2n} p_{2n-1}}) \,/\, p_{2n}.$$

Similarly, the fraction $\dfrac{x_{2n} - \sqrt{\mathrm{N}.\, y_{2n}}}{\sqrt{\mathrm{N}}\, y_{2n+1} - x_{2n+1}}$ will become

$$\frac{\sqrt{\mathrm{N}.(x_{2n} y_{2n+1}} - x_{2n+1} y_{2n}) + (x_{2n} x_{2n+1} - \mathrm{N}\, y_{2n} y_{2n+1})}{\mathrm{N}\, y_{2n+1}^2 = x_{2n+1}^2}$$

or

$$(\sqrt{\mathrm{N}} \pm \sqrt{\mathrm{N} - p_{2n+1}\, p_{2n}}) \,/\, p_{2n+1}.$$

Now, we have made the condition that the values of λ should be the greatest possible ; hence in each case the upper sign of the ambiguity must be taken. This necessitates that

$$x_r x_{r-1} - \mathrm{N}\, y_r y_{r-1}$$

should be *negative* or *vositive* according as r is *even* or *odd*.

If, then, we assume that such values of the successive x's and y's can be found, we have in all cases

λ_r is the greatest integer in $(\sqrt{\mathrm{N}} + \sqrt{\mathrm{N} - p_r p_{r-1}}) \,/\, p_r$. ... (A).

On the other hand, if we employ the formula (A) to find the successive values of λ, we have a definite method of determining the new values of x and y from any two given consecutive pairs of values for x and y. Substituting these new values in $x^2 - \mathrm{N}\, y^2$, we obtain a new p ; and with this we can calculate a new λ ; and so on.

But, if the sole object of the work is to obtain a solution of the equation $x^2 - N y^2 = 1$, the calculation can be greatly shortened in the more difficult cases. For, a formula can be found which will enable us to calculate the successive values of p, without the substitution mentioned above. In fact, the values of the successive x's and y's need not be determined until we arrive at the value 1 for p.

For,

$$x_r x_{r+1} - N y_r y_{r+1} = \lambda r(x_r^2 - N y_r^2) + x_r x_{r-1} - N y_r y_{r-1};$$

hence, paying due regard to the signs of the several expressions, we have, whether r is odd or even,

$$\lambda_r = (\sqrt{N - p_{r-1} p_r} + \sqrt{N - p_r p_{r+1}}) / p_r \ldots . \quad (B)'.$$

The calculation can be conveniently set out as below:

Make out a tabular form, heading the columns 0, 1, 2, 3, etc., and designating the rows by $\sqrt{N - p_r p_{r+1}}$, $v_r p_{r+1}$, p_{r+1}, λ_{r+1}; fill up the first colum with a (= integer next less than N), b (= $N - a^2$), c (= b), and d (= greatest integer in $2a/c$).

For the second column, take a' (= $cd - a$, by formula [B]), b' (= $N - a'^2$), c' (= b'/c), and d' (= integer next less than $(a + a')/c$, by formula [A]); and so on for the succeeding columns, remembering that, in determining the figure in the fourth row, that the a, the integer next less than $\sqrt{N}$, persists throughout; *i. e.*, for the third column, d'' is the integer next less than $a + a''$, and not that next less than $a' + a''$.

For example, let N = 31, and $a = 5$

N = 31; integer next less than $\sqrt{N} = 5$

$\sqrt{N - p_r p_{r+1}}$	5	1	4	5	5	4	1	5	
$v_r p_{r+1}$	6	30	15	6	6	15	30	6	
p_{r+1}	6	5	3	2	3	5	6	1	
λ_{r+1}	1	1	3	5	3	1	1		

The values of x and y can now be calculated:

$y_1 = 1, y_2 = 1.y_1 + 0 = 1$, $y_3 = 1.y_2 + y_1 = 2$, $y_4 = 3.2 + 1 = 7$,
$y_5 = 5.7 + 2 = 37$, $y_6 = 3.37 + 7 = 118$, $y_7 = 1.118 + 37 = 155$,
and $y_8 = 1.155 + 118 = 273$.

and similarly for the value of x. But, in general, it will be easier to

calculate x from the formula $\sqrt{Ny^2+1}$. Here we have $y^2=74529$, and $x = \sqrt{2310400} = 1520$.

It remains but to prove that the value 1 for p is always obtained in this manner. It is obvious from what has been proved that the product $p_r p_{r+1}$ must be equal to N — (a square); and of the latter numbers there is only a limited selection: that is there are only a limited number of values for the product $p_r p_{r+1}$; and even of this limited number, as we shall see later, some may be ineligible.

Suppose, for example that there are five possible products, A, B, C, D, E, say. Then one of these products, A say, is $p_1.1$; the next product $p_1 p_2$ contains p_1 as a factor, which we will suppose to be B; the third, C say, contains p_2 as a factor, the fourth, D say, contains p_3, and therefore the last, E, must be $p_3 p_4$. From this the return must be made to D, thence to C, to B, and to A; and since this is $p_1.1$, and the factor from B was p_1, it follows that the next p must be unity; the sign will be *plus* if the suffix is *even*; if the suffix is *odd*, the sign is *negative*, and we have a solution of the equation $x^2 - Ny^2 = -1$, from which, as can be readily seen, we obtain a solution to the equation $x^2 - Ny^2 = +1$, either by continuing the working for another complete period, or by conformal multiplication. Thus, if x and y satisfy $x^2 - Ny^2 = -1$, since we can write

$$(x^2 - Ny^2)^2 \text{ as } (x^2 + Ny^2)^2 - N(2xy)^2$$

$x^2 + Ny^2$, $2xy$ is a solution of $x^2 - Ny^2 = +1$.

If the products, A, B, C, D, etc., have some or all of them a large number of factors, the process of finding the values of p may not be so direct as that indicated above, each product or at least some of them being « visited » more than once. Again, for any factor of a product, left over on division by the preceding p, there may be more than one product possible. In the first case the number of possible combinations must be finite, and the return is made in exactly the opposite order, as before. In the second case, the order, which at first sight seems to be ambiguous, is made definite by the consideration that the sum of the square roots in formula (B), which is equal to the value of $\lambda_r\ p_r$, must be as great as possible, consistent with the fact that the sum is divisible by p_r, i. e., that λ_r is an integer. Hence since one of these square roots is already known, the other must be as large as possible, or the corresponding product must be as small as possible, consistent with the proviso of divisibility mentioned.

The foregoing remarks may be made more clear by considering specific examples.

Ex. 1. N = 31; here the products are 6, 15, 22, 27, 30; and the order is 6, 30 (= 6.5), 15 (= 5.3), 6 (= 3.2), 6 (= 2.3), 15 (= 3.5), 30 (= 5.6), 6 (= 6.1).

There is an important point to be noticed here. Since the only possible values, less than N, which the number p can have, are 1, −6, 5, − 3, 2, it follows that the equation $x^2 - Ny^2 = a$ does not admit of a solution in integers unless a (when less than N) is one of these numbers, or (when greater than N) can be reduced to one of these numbers, in the well-known manner.

Ex. 1. N = 61; the products are 12, 25,36, 45, 52, 57, 60; and the order is 12, 36 (= 12.3). Here we have chosen the lowest of the alternatives, because we know that λ must be 1. For the next we have four alternatives, 12, 36, 45, 57, and 50; $p_2\lambda_2$ is definitely given as 12, one square root is already known to be 5, hence the other must be 7, and the product required is $61 - 7^2 = 12$. In such a case, then, the whole table must be calculated, when the order will be found to be

12, 36 (= 12.3), 12 (= 3.4), 36 (= 4.9), 45 (= 9.5), 25 (= 5.5)
45 (= 5.9), 36 (= 9.4), 12 (= 4.3), 36 (= 3.12), 12 (= 12.1).

The calculation runs as follows:

N = 61; integer next less than $\sqrt{61} = 7$

$\sqrt{61 - p_r p_{r+1}}$	7	5	7	5	4	6	4	5	7	5	7	7	5	7	5
$p_r p_{r+1}$	12	36	12	36	45	25	45	36	12	36	12	12	36	12	36
p_{r+1}	12	3	4	9	5	5	9	4	3	12	1	12	3	4	9
λ_{r+1}	1	4	3	1	2	2	1	3	4	1	14	1	4	3	1

Here we have the value 1 appearing in the third line in the eleventh column, and therefore bearing a negative sign: thus $x_{11} = 29718$, $y_{11} = 3805$ gives a solution to the equation $x^2 - N y^2 = -1$; we must take a further period therefore, and calculate x_{22} and y_{22}; the values will be found to be.

$$x = 1766319049, \text{ and } y = 22615398.$$

This example is one of the cases proposed by FERMAT as a challenge; there is no great difficulty involved by the high numbers; for, given the aboven method, the calculation of the table is a matter of five

minutes' work ; and after that the calculation of x and y is merely arithmetical labour. Now, FERMAT evidently considered that they would prove troublesome, and I take it for some other reason : this reason is, I suggest, that FERMAT would almost expect the mathematicians he challenged to find out the matter of the products being perfect squares, and the troublesomeness of the particular case of the problem is provided by the difficulty in deciding which of the alternatives to take for the successive products, unless the whole scheme of the solution was divined. This is one reason why I think that I have given what was practically FERMAT's method. Another point is this ; FERMAT states (see HEATH's *Diophantus*) that he has a rule for determining whether an equation is soluble or not ; and this method gives the rule, as shown in Ex. 1. Lastly, the arrangement of the proof, as I have put it, explains clearly how the proof is derived step by step, *i.e.*, the process of FERMAT in its discovery. The first step of the formation of a sequence of fractions is obvious : then follows the proof that they are in descending order, and the numerator of the difference is brought out of constant form ; from this, the step to making it equal to unity, in order to get the approximations the closest possible ones with given denominators (or less), is clearly what is necessary to obtain a solution in smallest nmbers. Then the limit to λ as the greatest possible integer in certain fractions leads directly to the appearance of the expressions, which are proved to be square roots of $(N - p_r p_{r-1})$, by a natural rationalizing of the denominators ; and, quite naturally also, in order to make λ as great as possible, the signs of these expressions are determined as alternately plus and minus. FERMAT may have been assisted in this by knowing that those in which the highest suffix was even were negative, as he could have proved in three lines. But even without this, there was no necessity for the genius of a FERMAT, to arrive at formula (A) in a natural straightforward manner. Where it may have come in is in the discovery of formula (B); but here he may have been assisted by observation of the solutions of several easy cases with low values of N, endeavouring to find something that was exactly equal to λ. Hence I conclude that FERMAT did have a general proof, and that it was substantially what I have given.

(Derby.) J. M. CHILD.

Daniel of Morley

an English Philosopher of the XIIth century.

In the last quarter of the XIIth century there worked and wrote DANIEL OF MORLEY, who is interesting as one of the earliest of the group of Englishmen who did so much to organise the scientific movement of scholasticism. The chronological order of these men's activity was probably ADELARD OF BATH (fl. c. 1116), ROBERT DE RETINES (= ROBERT OF CHESTER, fl. 1150), translator of AL KHOWARIZMI's Algebra and of PTOLEMY's *De compositione astrolabii*, also first translator of the Koran, DANIEL OF MORLEY (about 1190), ALEXANDER OF NECKAM (1157-1217), MICHAEL SCOT (c. 1175-c. 1234), BARTHOLOMAEUS ANGLICUS (= DE GLANVIL, fl. 1230-1250), ROBERT GROSSETESTE (died 1253), ADAM MARSH (died 1257), ROGER BACON (1214-1294) and JOHN OF PECKHAM (died 1292).

But DANIEL was in certain respects the most interesting of the group for he was not only one of the earliest but, with the exception of ROBERT DE RETINES and MICHAEL SCOT, he was the only one with a first hand knowledge of Arabic. This he acquired in Spain, and the cause of his going there he sets forth in the introduction to a tract recently printed by SUDHOFF. « When » he says « I had betaken myself from England for the purpose of study and had delayed for a little at Paris, I saw there certain men of brutish intelligence occupying the Chairs in the schools with great authority, and they had before them two or three benches with books upon them so huge that they could not be carried, and these books displayed the traditions of ULPIAN in letters of gold. » ULPIAN was a Roman jurist of the IIIrd century whose works were much read in the middle ages, especially before the Arabian revival. It was no uncommon thing in the middle ages to write treasured works in golden letters.

DANIEL then goes on to describe the asinine pedantry of these professional exponents who sat « holding in their hands leaden styles with which they inscribed in their books asterisks and obeli with a show of reverence. And although from their ignorance they were but

images of men, yet by their mere reticence in reply they put on the appearance of wisdom; such men I found were indeed, like images, incapable of rational discourse. Now when I understood the state of affairs I determined in my own mind to avoid becoming like them, for after careful thought I saw that those arts, which throw light upon learning should not be greeted with a mere passing salutation or be gone over in a bare summary. Yet the teaching of the Arabs, the wisest philosophers in the world, was hardly to be found except in the *quadrivium* and was chiefly studied in Toledo. » By *quadrivium* is meant the higher and fourfold division of the seven liberal arts consisting of Arithmetic Geometry, Astronomy and Music. The lower and threefold division or *trivium* consisted of Grammar, Rhetoric and Dialectic.

Daniel thus tells how Arabian ideas had penetrated to the Quadrivium even before his time, and we know that ever since the year 1000, when at the instigation of the learned Pope Sylvester II (Gerbert) a treatise on the astrolabe had been translated from Arabic, the influence of Arabian learning on the mathematical group of studies had been a continuous and growing one. But by the end of the XIIth century when Daniel wrote, the force of Arabian learning in its original home was nigh spent. It is true that the great tradition lingered yet in Spain when Averroes (1126-1198), « the second Aristotle » still lived at Cordova aged, banished, and disgraced (1195). There in Andalusia the bigoted Moslem Almohàdes retained their hold, and into the south of the peninsula it was therefore not easy for a foreigner and a Christian to penetrate. But in the north, though the Moors had long since been driven from the kingdom of Castille, Arabic was still understood and spoken by elements in the Christian population. Moreover Castille was closely linked to England, for Alphonso VIII (1158-1214) the sovereign of that country had married Leonora, daughter of Henry II, who as duke of Aquitaine, by right of his marriage with the duchess Eleanor, had a strong direct interest in Spanish politics.

To Castille it was therefore natural that Daniel should repair for his self-appointed task of acquiring the Arabian culture. « To Toledo », he writes, « I hastened with all speed, that I might attend the lectures of the wisest philosophers of the world. But at last being invited by my friends to return from Spain, I came back to England with a valuable collection of books. When therefore I was told that in these parts the discipline of the liberal arts was hushed

and ARISTOTLE and PLATO were given over to oblivion, I was exceeding grieved, and that I might not remain a lonely Greek among the Romans I set out for a place where I had heard that this kind of study flourished. But while on my way I met my lord and spiritual father, JOHN, Bishop of Norwich, who received me courteously, after his wont, and congratulated me on my arrival. And when my lord had sufficiently questioned me, as at the meeting of friends, upon the wonders and studies of Toledo, he turned his conversation to astronomy and made searching inquiries about the movements of supercelestial bodies, and he asked me moreover concerning the sublunar bodies which seem to obey the superior bodies by a law of necessity. Since, however, time did not allow me to satisfy his enquiries he directed the preparation of this tractate. » The Bishop JOHN to whom DANIEL here refers was JOHN of Oxford, the enemy and opponent of BECKET by whom he had been excommunicated in 1166. JOHN was a busy and energetic man of affairs who had travelled considerably and in 1176 was commissioned to escort JOANNA the daughter of HENRY II to Sicily. He had been involved deeply in the triangular duel between BECKET, the king and the papacy and his support of the king earned him the bishopric of Norwich in 1175.

Thus then began the study of Arabian science in England, and it is chiefly for his relation to it that DANIEL OF MORLEY has a place in our memory. The change that it wrought in men's minds affected method even more than content. Vague ideas which had lain scattered in an irregular and fragmentary manner were placed in order and sequence and used as stones in building the majestic scholastic edifice that rose in the following century.

We have quoted the bishop's questions to DANIEL on the control that the stars are supposed to exercise over earthly affairs and we may briefly consider the function played during the scholastic centuries by Astrology « that law of necessity » as DANIEL terms it « by which sublunary things seem to obey the supercelestial bodies as by a law of necessity ». In our own time to describe man as an astrologer is to write him down a credulous fool. The system has been tried and found wanting and moreover the Copernican heliocentric system has made our earth but a star in the firmament of some greater order and removed it from its central position in the Universe. But this revolution in scientific ideas was undreamed of in the XIIth century. Still less had anything helpful been learned of the constitution and structure of matter and of the laws that govern the development of living

things. On the other hand the learned of that age had a limited yet accurate knowledge of the apparent movements of the heavenly bodies and the science of the Arabian professors bade fair to reveal a great deal more, though the vastly complex mass of terrestrial phenomena had as yet been reduced to no sort of order. It was in the heavens alone that the reign of law had been fully discerned; men therefore accepted eagerly the not uncomfortable doctrine that the laws thus traced extended also to our lower world and to the *minor mundus* man himself, for the belief that order reigns in Nature seems inherent in the intelligent human mind. After all the attribution of known and demonstrated laws to regions where the application of those laws has not yet been demonstrated, is a process not altogether unknown even among modern men of science.

The main basis of the new system, so far as material existence was concerned, was a parallel which, it was believed, could be established between the external and the internal world, the Macrocosm and the Microcosm, Man and the Universe. Nor did the interrelationship stop here, for the characteristics of the four elements or four humours entered also into the moral world wherein parallels were discerned that were far more than merely *analogous* to the events in the external universe. Here is DANIEL's statement of the curious scheme. « The human body consists of four humours, assimilated by it from the elements of this world; for red bile obtains its quality from fire, blood from air, phlegm from water, and black bile (melancholy) from earth. If fire, *i. e.* red bile is disturbed a man becomes paralytic, if air *i. e.* blood is disturbed he becomes polypous, if water *i. e.* phlegm is disturbed he becomes dropsical, if earth *i. e.* melancholy, is disturbed he becomes leprous... The body of man, as has been said, is composed of the four elements, from fire which by nature seeks higher regions he has the light of the eyes, from air shapen and moulded comes words, from earth the bulk of body and from water comes the organs. From these again when they overpass certain limits of their measure yet another four qualities spring up, to wit, inquisitiveness in the eyes, talkativeness in the tongue, cruelty in the hands, passion in the loins. Inquisitiveness arises from insolence of the sight, talkativeness from levity of the tongue, cruelty from brutish corpulence, and the itch of passion from superfluity of humours which are carried down to the loins in their endeavour after expulsion. »

« Having shown therefore, of what diverse qualities man consists,

both in mind and body.... I turn to the constitution of the world and because it is not seemly for a wise man who is but a guest in this earthly caravanserai to be ignorant of the nature of his own dwelling place, his spacious universal home, I have appended in Latin what I learned in the speech of Toledo from GALIPPUS the Mozarab. » Mozarab, — *Mixtarabus* is the word used by DANIEL — is a name attached to the Arabic speaking Christians of Spain who formed a large proportion of the population of that peninsular throughout the period of Moorish rule. GALIPPUS is perhaps identical with GHÂLIB, a Spanish Christian who is recorded as the first teacher of the greatest of all the Latin translators from the Arabic, GERARD OF CREMONA (1114-1187). From the statement of DANIEL it is evident that GALIPPUS gained much of his knowledge from the Timaeus of PLATO, a source which makes us doubt a little his competence in Arabic. The substance of the Timaeus was known from a very early date in a Latin commentary of a IV^th century writer, CHALCIDIUS, whose work is important as one of the main sources of scientific teaching in Europe in the century immediately preceding, the great scholastic revival. CHALCIDIUS had Neoplatonic leanings and the kind of view that he. propounded, through the medium of his commentary on the Timaeus, may be gathered from such a passage as that which we here translate from DANIEL. The passage consists of the Mozarab's refutation of CHALCIDIUS :—

« Some assert that this world was formed from chaos, and such men say that chaos was *yle* which is the name they give to primal matter, which CHALCIDIUS, commenting on PLATO with perhaps less foresight, said was erected by God without order. For he says « God desired all things to come forth good » and then added « the wise arranger of all reduced to order everything visible and corporeal which was floating with ceaseless motion and never at rest from disorderly tossing to and fro, to give form to what was confused without order »... But why, CHALCIDIUS, do you call *yle* unordered and assert it was created by God? For weakness is far removed from perfection and badly arranged work accuses its author of imperfection. For if as you say, God first created something without order and afterwards brought it into order and corrected what he produced, if he corrected, he altered it, but who does not know that to alter his work is the mark of a weak craftsman? » *Yle* is of course the *hyle* (= matter) of PLATO and is opposed to *nous* (= mind). Similar views and similar phraseology are encountered in the works of DANIEL'S

contemporary, BERNARD SYLVESTRIS (flourished about 1130) who took them from the Arabic translator hunchbacked HERMANN (HERMANNUS CONTRACTUS), and not very different is the outlook of HUGH OF ST. VICTOR (1095-1141) and of HILDEGARD OF BINGEN (1098-1180). DANIEL OF MORLEY thus falls into that series of mediaeval scientifique writers on whom the leaven of Arabian philosophy first began to work and his place is intermediate between the mystics of the XII^th^ and the scholars of the XIII^th^ century.

Discussion of material of this kind, barren and foolish though its authors now seem, helps us to take a step further back in the history of scientific thought. The recent publication of DANIEL's tract by KARL SUDHOFF brings us a little nearer to the consummation to which all historians of science look forward when the chain of scientific thought may be traced as one continuous story throughout the centuries. Such work aids in the destruction of the delusive method of those writers who tacitly inculcate the absurd doctrine of the discontinuity of thought by supposing that the history of science can be written in isolated sections which, like the *hyle* of CHALCIDIUS, they would have us believe were created from nothing.

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(Oxford) CHARLES SINGER.

Notes and Correspondence

First Congress of the History of Medicine. (Antwerp, August 1920). — This congress is scheduled to take place from Aug. 7 to August 12 that is at the time of the famous Antwerp Kermess and of the fifth Olympiad. The following program is arranged :

1. Études historiques sur l'Assistance publique en tous pays. Dans cet ordre d'idées, M. le Prof. JRANSELME parlera de l'Assistance publique à Byzance.
2. L'Iconographie médicale.
3. La médecine monastique et collégiale en Belgique.
4. Bibliographie de l'Histoire de la Médecine. A ce propos, M. FANIEN, directeur de la Bibliothèque municipale de Nancy, étudiera la bibliographie des œuvres médicales qui ont pris naissance en Lorraine.
5. Le mobilier des apothicaires.
6. Epigraphie médicale; continuation de l'œuvre commencée par le regretté Prof. BLANCHARD.

The publication of a *Liber memorialis* will give us later another opportunity to speak of this meeting. G. S.

La Revue générale des Sciences. — *La Revue générale des Sciences pures et appliquées*, fondée en 1890 par LOUIS OLIVIER, a célébré en 1914 son XXV^e^ anniversaire. La guerre m'a empêché à ce moment de rendre à cette grande revue l'hommage qu'elle mérite, mais il n'est jamais trop tard pour bien faire et je tiens à dire ici brièvement mais fortement ce que j'en pense. *La Revue générale des Sciences* est de beaucoup la meilleure revue de son genre à l'heure actuelle. Elle est plus méthodique et mieux rédigée que toutes les autres revues que je connais et permet mieux qu'aucune autre de suivre le progrès de la science. A vrai dire elle a un peu décliné pendant la guerre mais nul n'oserait lui en faire un reproche et j'espère de tout cœur qu'à mesure que la vie française redeviendra plus normale, la revue s'améliorera et redeviendra le grand organe scientifique international qu'elle était avant la guerre. Le directeur actuel est le D^r^ J.-P. LANGLOIS; l'éditeur, O. DOIN, Paris (6^e^), 8, place de l'Odéon, et l'actif secrétaire, LOUIS BRUNET. Une des qualités les plus appréciées de la revue est l'excellence de ses tables qui permettent d'y retrouver très vite les renseignements

désirés. C'est à cause de ses tables que je fais relier cette revue (c'est la seule revue des sciences que je fasse relier; des autres je ne conserve que les articles qui m'intéressent). A l'occasion du XXV[e] anniversaire une Table générale des matières contenues dans les vingt-cinq premiers volumes (1890-1914) a été publiée et constitue la fin de l'année 1914 (76 p.). Elle comprend une table analytico-alphabétique des matières, et une table alphabétique des auteurs. Cette table sera très utile pour toutes les recherches relatives à l'histoire des sciences pendant la période considérée. G. S.

Catalogue of early scientific manuscripts in the British Isles. — It gives us great pleasure to publish the following note written by Mrs. DOROTHEA WALEY SINGER herself, in which she explains the great work which she has undertaken with the assistance of her husband, Dr CHARLES SINGER and other scholars. G. S.

The Catalogue is designed to furnish the material for a study of the retrogression and subsequent rise of science during the 1000 years that intervened between the Greeks and the Renaissance.

It may be objected that this was an inglorious period for science. But the seeker after knowledge, the student of human progress will not believe that only the golden periods of the human race are worthy of study. Surely we may learn from evil besides from good example, and the spectacle of the gradual crumbling of the magnificent structure of Greek science cannot fail to implant a healthy reflection in the mind of the student of today. Is our own science absolutely safe? How may we most surely avoid the pitfalls of our predecessors? Since credulity and subservience to authority were the outstanding features of the successive periods known as the Dark and the Middle Ages, we may hazard the suggestion that one line of safety for us may lie in the avoidance of anything approaching a hierarchy in modern science.

But there is another aspect to the study of mediaeval writings on science. They are the germs from which arose the wonderful developments of later centuries. To gain a complete understanding of what modern science is, we must have an adequate account of how science came to be. Just as every human being is the outcome of environment acting on heredity, so are we coming to realise that every advance in scientific thought arises from the effort of a mind or group of minds reacting to the stimulus of other minds of their own and of preceding periods. Thus the Middle Ages provide the Embryology as well as the Pathology of science.

But the sources of mediaeval science lie buried in manuscript form,

in many libraries large and small. The vast majority of these works are unprinted, unedited. Some finger-post is therefore imperative among the mass of material. The first urgent necessity has been a list of the texts, classified by subject and date. If, for example, anatomy alone be considered, there gradually emerges something like a continuous story, from the days of Greek thinkers to our own time. This continuity, however, with all its vicissitudes cannot be traced until the Mss on the subject have been examined and compared over successive centuries, a work in which Dr. SINGER is pretty far advanced. I am similarly examining the Plague tractates, while a work on the Lapidaries is hoped for soon from Miss JOAN EVANS, and one on the Herbals from Mrs AGNES ARBER.

So also for other subjects; the material has to be segregated and sorted, a process greatly facilitated by the cheap rotographs, or fixed negative photographs, that enable us to obtain copies, facsimiles of the original Mss in all but colour. These rotographs can be examined at leisure in our own homes, and similar works can be laid side by side for *comparison*, the indispensible key to all sound scientific work. I would add that although the complete science of palaeography is of course a life study, scientific works written before the fifteenth century are usually remarkably clear and legible. I have the support of expert palaeographers in assuring the student that amonth's work will probably give him the mastery of any (except the worst!) single style of handwriting, while a week's work will seldom fail to make him completely at ease with the writing of any one scribe. Excellent dictionaries are published of the abbreviations in common use in mediaeval writings while I have myself prepared and shall be pleased to lend a small notebook of the most usual abbreviations in medical manuscripts.

But before we can examine the texts, we must know where the original manuscripts exist, and for this purpose the catalogue has been compiled. It is arranged primarily under subjects, and subdivided chronologically into centuries, and an attempt has been made to group cognate texts together within each century. There is a comprehensive combined index of names, places, subjects and languages, and a second index giving an alphabetical list of all manuscripts cited.

The catalogue is compiled mainly from a very great number of published works and as these differ, to some extent, in scope and form, some disparity will be observed in our entries. But where the published catalogues do not even give dates, the manuscripts themselves have been examined and dated, a work in which Dr SINGER and I have received invaluable help especially from Mr. J.P. GIBSON, Mr. R.R. STEELE and Miss M.V. TAYLOR.

We have tried to give in every entry the shelf mark and exact foliation of the text, besides subject, century, language, author if known, opening words, and any available information as to provenance. Illuminations and drawings, when known, are always mentioned.

The headings of the Catalogue are as follows :

Alchemy and chemistry.
Anatomy.
Aristotle.
Arts and Crafts.
Astrology and Menology.
Astronomy.
Bestiaries, Monstrosities and Fables.
Calendar.
Computus.
Charms and Magic.
Children.
Cosmology.
Diet.
Fermentation and Generation.
Fevers.
Geography and Travel.
Gnomic.
Gynaecology.
Haematoscopy.
Herbaria.
Hospitals.
Husbandry.
Lapidaries.
Marvels.
Mathematics.
Measures and Weights.
Medicine (general).
Melothesia.
Miscellaneous.
Music and Harmony (scientific aspects).
Ophthalmology.
Pestilence, Epidemics and Infection.
Phlebotomy.
Physics.
Physiogonomy and Cheiromancy.
Physiology (4 Complexions, etc.).
Prognostics.
Pulses.
Recipes (Medical) and Drugs.
Regimen.
Science (general) and Encyclopaedias of Gen. Knowledge.
Surgery.
Urine.
Veterinary.

A word of explanation is needed as to these categories. They do not, of course, in any sense, represent a scientific classification. We have had to deal with some 40,000 entries and they quite refuse to fit into the ordinary subject headings of modern science. The mediaeval classification, on the other hand, would be very inconvenient, for there would be too few headings and such as there were would carry no immediate significance except to mediaeval scholars. We therefore decided to adopt those subject headings into which we found that our own material most readily grouped itself. It will be observed that the word « science » has been stretched to include all that body of semi-magical lore in which are so often found unexpected seeds of science and medicine as understood by us.

Thus our Catalogue offers a guide to a wide range of mediaeval material. We can provide for the most varied and for the most specific taste in research, for our detailed indices enable us to turn up at once the relevant material of any period, in any language or from any one of our authors. It may be added that more than half our total number of entries deal with medical or quasi-medical subjects.

It is our hope that ultimately all the important Mss in the Catalogue will be examined in rotograph or otherwise and that they will form the material for a series of monographs on which may be based the mediaeval and pre-mediaeval portions of a great History of Scientific Thought, to be built up by many workers, somewhat on the lines of such a production as the Cambridge Modern History.

I would plead for volunteers for the task of reading these Mss. If anyone will undertake a whole section of the catalogue we shall, of course, be delighted; or if anyone cares to transcribe or publish only a small group or a single manuscript, we shall no less gratefully welcome his or her help. I would indeed venture to suggest that this exploration and exploitation of the frail literary treasures of our country is a national service that may command from future generations a measure of gratitude no smaller than that awarded to other more immediately and tangibly utilitarian labours. If the work had to be limited to the Mss of one country, Great Britain is probably the most suitable owing to the relative immunity of her libraries from the ravages of war. But perhaps the Catalogue may be extended on an international basis.

In the compilation of our Catalogue, we have had the great encouragement of grants from both the Royal Society and the British Academy. The help from these two bodies symbolises that cooperation of science with humanism that we hope will be fostered by the growing study of the history of science.

(Oxford). DOROTHEA WALEY SINGER.

The History of Science in America. — The three following items are quoted to show that there is in the United States a growing interest in our studies.

(1) *Conference on the history of science at Cleveland* (Dec. 31, 1919). At the last annual meeting of the American Historical Association at Cleveland, Ohio, a special symposium under the chairmanship of GEORGE L. BURR was devoted to the history of science. Papers were read by T. WINGATE TODD, LYNN THORNDIKE, L. C. KARPINSKI, HENRY CREW; WILL A. LOCY, HARRY E. BARNES, WAL. LIBBY and CH. H. HASKINS took part in the discussion. A good summary of this conference by LYNN THORNDIKE will be found in *Science*, vol. 51, p. 193-194, New

York, 1920. Another summary will presently appear in the *American Historical Review*. The American Historical Association must be warmly congratulated for this initiative. Speaking of this it is interesting to note that as a result of much correspondence on the subject in *Science*, it is likely that a section partly or entirely devoted to the History of Science will be organized by the American Association for the Advancement of Science. In so doing the A. A. A. S. will follow the lead given by the sister associations in Germany and Italy.

(2) At the request and with the collaboration of the *National Research Council*, — the American Telephone and Telegraph Company and the Western Electric Co., inc. prepared in the beginning of 1920 an exhibit of apparatus designed to reproduce the more fundamental electrical discoveries of the XIXth and XXth cent. which have paved the way for the Wireless Telephone. The exhibit took place in the home of the N. R. C., on 16th str., 1023, Washington D C. On this occasion a most interesting booklet called « Scientific Discovery and the Wireless Telephone » (28 p., without place or date) was distributed. It is clearly and well written and due emphasis is laid upon the importance of pure research. The greatest cause of progress is perhaps the scientist's perpetual craving for knowledge : « Necessity may be mother of invention but necessity has seldom been the mother of scientific discovery. » Yet so successful, even from the utilitarian point of view, has been man's longing for knowledge for the sake of knowledge, that there is a constant temptation for him to seek knowledge *because* it is useful.

« Herein lies a grave danger of losing the true perspective. It is but a step from seeking Knowledge because it is useful to seeking useful Knowledge. But no touchstone has been vouchsafed man by which he may readily determine the usefulness of the discoveries he makes. The pratical value is often slow in being brought to light. »

The same idealistic tendancy appears throughout the booklet and is made more tangible by the reproduction of six portraits : HUYGENS, OERSTED, FARADAY, HENRY, MAXWELL and HERTZ. The last paragraph of the Conclusion is worth quoting, chiefly because it expresses the views of two great *industrial* concerns :

The efforts of the host of practical scientists throughout the world who are advancing the wireless art by the invention and development of better radio devices are manifested by the state of the art itself, but the work of the pioneer scientists, which has been of equal and perhaps greater value, is not so obvious. Indeed, the work of these pioneers is often overlooked by the very people, the

public, who benefit most by their work. For instance, it is not very apparent that a HENRY seeking to understand the laws of the electromagnet, or a FARADAY absorbed in the transformation which a beam of light undergoes in traversing a magnetic field, or a MAXWELL, who with paper and pencil is making guesses as to the structure of the ether, is doing a work without wich there could be no wireless telephone. This is a fact we cannot bear too much in mind. The number of HENRYS and FARADAYS and MAXWELLS of whom the world is in possession at any one time is very limited, and because their labors, if not immediately, are certain eventually to find many applications, they should be given every aid and encouragement. Of this principle, the history of the wireless telephone is merely typical. By altering a few names and statements of fact, and in no wise changing the underlying thought, any one of many practical applications and processes might be substituted above for the wireless telephone. Take, for example, the incandescent lamp, the X-rays, radium, antiseptics and antitoxins, the fixation of nitrogen, and the modern methods of soil fertilizations, — in every case we would find the evidence pointing to the conclusion that the abstract scientist and the reclusive philosopher of one generation are preparing the way for the technician of the next; that the scientific laboratory of one generation becomes the workshop of the next, that the « useless » theory of one is the practice of the next; in a word, that for guiding all research there is no higher principle than this, — « Know the truth, and the truth shall make you free. »

(3) The *Centennial of the Discovery of Electromagnetism* was celebrated on April 20, 1920 by the Sigma Xi fraternity at the Northwestern University, Evanston, Illinois, addresses being made by LYNN HAROLD HOUGH and WALTER CLYDE JONES on OERSTED's fundamental discovery. G. S.

Reviews

Philip E. B. Jourdain. – The Flying Arrow: an Anachronism. *Mind*, vol. XXV, p. 42-55. Aberdeen, 1916.

The first part of this article (§§ I-IX) contains an attempt at an interpretation of ZENO's arguments about motion, together with a criticism of many former interpretations. In particular, the views of P. TANNERY, G. MILHAUD, M. CANTOR, BRUNSCHVIG, S. T. COLERIDGE, H. HANKEL, E. MACH and A. E. TAYLOR are criticized. The author's view is that all four arguments are directed against the belief held by most people of that time (including the Pythagoreans and EMPEDOCLES), and still always held by unsophisticated people, that lines are made up of points. There is not an analogy between these arguments and ZENO's arguments against the unit; for in the arguments on motion there are some (the two last) which make no use of the principle of dichotomy, and seem to be directed against the view that space and time are composed of a finite number of points and instants respectively. Thus the whole four arguments seem to try to prove that motion is impossible on any pluralistic hypothesis. (1) If we admit infinite divisibility, and thus maintain that the points and instants are *infinite* in number, then (*a*) the first argument shows that motion can never *begin*; (*b*) the second argument shows that the slower moves as fast as the faster, and that the infinite divisibility of time is irrelevant. Both these conclusions arise merely from the supposed self-contradiction in infinity; and this depends, as we can see nowadays, on an ambiguity in the word « infinity ». (2) If, then, we give up the principle of infinite divisibility, and consequently assume that space and time consist of a finite number of indivisibles, we see that (*c*) the flying arrow is always at rest; (*d*) a body travels twice as fast as it does. The second part (§§ X, XI) contains a generalization of the argument of the Arrow to certain « everywhere dense » aggregates, which disproves one of RUSSELL's contentions, and a new « proof » that the Arrow does not move for a *continuous* space and time, which is disproved by the modern theory of aggregates. Indeed, the disproof depends on the known fact that an enumerable set of intervals which

contain within them all the points of an everywhere dense but enumerable set need not always include all the points of the derived set.
(J.)

Aristotelis Meteorologicorum Libri Quattuor. — Recensuit indicem verborum addidit F. H. FOBES, XLVIII + 235 p. Cantabrigiae Massachusettensium e typographeo Academiae Harvardianae, MDCCCCXVIIII. [3.50 doll.]

The text of this new critical edition is based on recollations of the four Mss. used for BEKKER's édition (Berlin, 1831), collations of four additional Mss. (including two from the XII^th century and one of the early tenth), the evidence of the Greek commentators (ALEXANDRUS APHRODISIENSIS, OLYMPIODORUS, Io. PHILOPONUS) and the Arabic-Latin version by HENRICUS ARISTIPPUS († 1162) minister of WILLIAM I of Sicily. A full critical apparatus stands at the bottom of each page. This edition is the fruit of studies pursued for more than seven years. The text is preceded by : (1) a preface containing the genealogy of the Mss. and the list of variants between this and BEKKER's edition; (2) a list, with brief descriptions, of more than forty Mss.; (3) a bibliography, selected but without critical notes and not even classified; (4) the Epitome of the Meteorology as published in ERASMUS' third edition (Basel, 1550). It is followed by an index of all the words used in the text and by a synoptic table of the pagings of several earlier editions.

It is clear that we owe to Prof. FOBES a fundamental addition to our knowledge of the Aristotelian text and full credit must be given to him for his zeal and ingenuity and to the Harvard University press for the remarkable way in which the fruit of his labour has been published. At the same time one can but regret that the author has restricted himself so rigidly to the philological side of the question. It is of capital importance that a text like this be published as correctly as possible but that is only a means to an end. The end is the reading and the study of the text. One would expect the Preface to a text as interesting as the Meteorology to give us a summary of the many problems which it suggests. But we find nothing of the kind in it. A preface, even a Latin preface is meant to be read. Prof. FOBES does not seem to be aware of this since he includes in it an unreadable list of variants which should have been rejected into an appendix. A preface should be a prelude; it should gradually awaken our interest and curiosity and allure us to read the book. Instead of this, Prof. FOBES' preface is so chilly that he seems to have taken it for granted that nobody would read his book anyhow!

The bibliography given by the author being uncritical, I beg to draw the reader's attention to three of the many titles included in it. One

is an interesting paper by the author himself : « Mediaeval versions of ARISTOTLE's Meteorology » *Classical Philology*, X, p. 297-314, Chicago, 1915. The second is EDM. O. VON LIPPMANN, « Chemisches u. Alchemisches aus ARISTOTELES », *Archiv für die Gesch. der Naturwiss. u. der Technik*, II, p. 233-300, 1910 (reprinted in his Abhandl. u. Vortr. zur Geschichte der Naturwiss., vol. II, Leipzig, 1913). The third by INGEBORG HAMMER-JENSEN of Copenhagen, « Das sogenannte IV. Buch der Meteorologie des ARISTOTELES », *Hermes*, vol. 50, p. 113-136, Berlin, 1915, is a very clear study of the many problems involved in book IV of the Meteorology. HAMMER-JENSEN's conclusions are briefly the following : the real fourth book which should begin with the last chapter of book III and deal with minerals, is probably lost and replaced by the present one. On the basis of external and internal evidence, it appears that the present treatise is the work of STRATO, a disciple of ARISTOTLE who taught from 287 to 269. It is of considerable interest being so to say the first treatise of theoretical chemistry. The reader disappointed by FOBES' preface may turn to these three papers for some of the information which the preface itself should have offered him. — I had the curiosity to use the Index to find out whether the vocabulary of book IV is very different from that of books I to III. Now of the words beginning with α alone there are not less than 63 used in book IV exclusively, many of them many times. This may suggest a new way of studying the genuinety of this book, though I realize that its careful application would require a great deal of trouble.

GEORGE SARTON.

Dubreuil-Chambardel, L. — *Les médecins dans l'ouest de la France aux XI^e^ et XII^e^ siècles.* In-8° XII + 292 p. Paris, chez le Secrétaire général de la Société française d'Histoire de la Médecine, 16, rue Bonaparte, 1914

The greatest difficulty in writing a history of medicine is caused by the presence of certain large gaps in our record. One of the most extensive is encountered in Western Europe in the Dark Age, a period which for medicine extends from the IV^th^ almost to the XII^th^ century. This hiatus is however gradually being filled and the labours of the editors of the *Corpus Medicorum Latinorum* and the labours of KARL SUDHOFF and others on manuscript material are helping much towards this. M. DUBREUIL-CHAMBARDEL has applied himself to a somewhat different though no less needed task. He has industriously collected from cartularies and from patrological and liturgical documents all the references to the practice of medicine together with medical allusions within the limits of time and space that he has set himself. He has not

himself gone to the MS sources but the extent of his reading in patrological and liturgical literature will make this work a valuable source book when the time has arrived for joining up the two severed sections of Western medicine. It is perhaps a pity that in a work of such sustained industry he has not made a more considerable effort to link up his valuable local material to the general history of politics, religion and medicine. The insertion also of a few outline maps would have made his account far easier for the foreigner to follow. Nevertheless, the mediaeval medical historian has to thank him for a most valuable addition to one of the darkest and most confused of his departments of research. For the table of contents and bibliographical note, see *Isis*, II, p. 438-439. CHARLES SINGER.

A. G. Little. — *Studies in English Franciscan History*, being the FORD Lectures delivered in the University of Oxford in 1916. In-8° x + 248 p. Manchester, at the University Press, 1917. [8/6]

There is no stranger and more impressive chapter in the whole history of thought than that of the early history of the Franciscans. Within the memory of men who had known the saintly founder of the order (1181-1226), the « penitents of Assisi », the « friars minor » sworn as « jongleurs of God » to bring CHRIST cheerfully to the humblest and the meanest, sworn to possess nothing, to earn their bread from day to day by the work of their own hands or at need by begging, forbidden to lay by store or to accumulate capital, this order of humble servants of the poor had produced a series of monumental and scholarly intellects who between them initiated what bid fair to be a Renaissance of Science and Letters. But it is perhaps more remarkable still to find that it was from another group of almost equally able men of the same order that emanated some of the most effective weapons for resisting this very movement. To both parties the English Franciscan houses contributed an overwhelming share, to the former or scientific party, as we may call them, belonged ROBERT GROSSETESTE, Bishop of Lincoln, JOHN PECHAM, Archbishop of Canterbury, the elusive ADAM MARSH and above all ROGER BACON; to the latter or theological party are attached the names of ALEXANDER HALES, DUNS SCOTUS and WILLIAM of OCKHAM.

The primary inspirer of the scientific movement was undoubtedly the great bishop of Lincoln himself and its aims as set forth for us by his pupil ROGER, were chiefly mathematical and linguistic. « Nobody, says BACON, can attain to proficiency in the science of mathematics by the method hitherto known unless he devotes to its study thirty or forty years, as is evident from the case of those who have flourished in those departments of knowledge, such as the lord ROBERT of holy

memory, and Friar ADAM MARSH. . . . and that is the reason why so few study that science. » Again : « There were found some famous men, as ROBERT, Bishop of Lincoln, and ADAM MARSH, and some others, who knew how by the power of mathematics to unfold the causes of all things and to give a sufficient explanation of human and divine phenomena ; and the assurance of this fact is to be found in the writings of those great men, as, for instance, in their works on the impression [of the elements], on the rainbow and the comets, on the sphere, and on other questions appertaining both to theology and to natural philosophy. » Further : « All the saints and Latin philosophers and poets have had knowledge of foreign languages, and all the wise men of old, many of whom we have seen to survive to our time, such as the bishops of Lincoln and St. David's, and Friar ADAM MARSH. » These three men — GROSSETESTE, afterwards Bishop of Lincoln, THOMAS WALLENSIS, afterwards Bishop of St. David's and Friar ADAM MARSH — were among the first four lecturers to the Franciscans at Oxford, and gave to the school its distinguishing characteristics, namely, the study of mathematics as the basis of physical science, and the study of languages.

It is interesting to trace the subsequent fate of the two departments of study — linguistic and mathematical — initiated by the « scientific » Franciscan group. Prof. LITTLE thus summarises the course of these two studies in the centuries that followed : « If the XIII^th century revival of letters died an early death (choked by logic), and had no direct influence on the later Renaissance, it was different with the scientific movement. The interest taken in ROGER BACON's works was continuous. Friar THOMAS BUNGAY, whom ancient tradition associates with BACON, was the tenth lector to the Friars at Oxford. JOHN PECHAM, the eleventh lector, studied mathematics and optics under BACON, and was first attracted and finally repelled by his astrological theories. WILLIAM HERBERT, who afterwards became lector at Oxford, was at Paris about the time of BACON's death and diligently collected MSS. of his works for the friary at Hereford. Before the end of the XIII^th century attempts were made to « edit » BACON by collecting together passages from his writings bearing on the same or kindred subjects. PIERRE DUBOIS recommended the study of his mathematical work at the beginning of the XIV^th century. The large number of MSS, of his *Perspectiva*, or Optics, still existing, some of them « school copies », and references to it in disputations at Oxford show that the work was studied and regarded as authoritative in the XIV^th and XV^th centuries. But his influence extended beyond the Middle Ages ; through PIERRE D'AILLY and the *Imago Mundi* BACON reaches out his hand to COLUMBUS ; through PAUL OF MIDDLEBURG and the reform of the

calendar, to COPERNICUS. BACON was not an isolated phenomenon, but an important link in the chain of scientific development. »

It is a great thing to have from the hands of a scholar of the eminence of Prof. LITTLE a succinct and readable account of the very recondite and inaccessible aspects of mediaeval life in which his own studies have been mainly cast. In the course of those studies he has thrown a flood of light on the real origins of modern science and he has done much to remove the reproach that the works of ROGER BACON, the first of modern philosophers, remain inaccessible and still largely unedited. The « Studies in English Franciscan History » contains an important and interesting chapter in the History of Science, written out of the fullness of first hand knowledge and with a literary charm all too rare in works on mediaeval literature.

CHARLES SINGER.

F. Cajori. — OUGHTRED's Ideas and Influence on the Teaching of Mathematics, *Monist*, t. 25, p. 495-530. Chicago, 1915.

A continuation of CAJORI's articles on the life and works of WILLIAM OUGHTRED dealt with in other notices. From the quality of the books he published, from his prefaces and from passages in his controversial writings, it is gathered that OUGHTRED specially emphasized : — An appeal to the eye through suitable symbolism; rigorous thinking; the postponement of the use of mathematical instruments until after the logical foundations of a subject have been thoroughly mastered. OUGHTRED felt that the almost total absence of mathematical symbols renders the writings of the ancient Greek mathematicians unnecessarily difficult to read and he made a very extensive use of symbols, some of which have survived at the present day. CAJORI also gives NEWTON's opinion of OUGHTRED, compares OUGHTRED and HARRIOT, mentions OUGHTRED's pupils and discusses the question as to whether DESCARTES was indebted to him. CAJORI does not go as far as does BOSMANS, and thinks that unless DESCARTES actually examined a copy of OUGHTRED it is not likely that he was influenced by him in appreciable degree. Yet CAJORI is led to the conviction that OUGHTRED deserves a higher place in the development of algebra than is usally accorded to him; but that it took many years for his influence fully to develop. J.

F. Cajori. — The Works of WILLIAM OUGHTRED. *Monist*, vol. XXV, p. 441-466. July, 1915.

This article contains a description of OUGHTRED's mathematical work. His *Clavis Mathematicæ*, which first appeared in 1631, contained in very condensed form the essentials of arithmetic and algebra

as known at that time. As compared with other contemporary works on algebra, OUGHTRED's work is distinguished by the amount of symbolism used, particularly in the treatment of geometrical problems. However he still used a dot to denote ratio although he was familiar with NAPIER's use of the dot for the decimal point. He introduced a new and interesting feature in an abbreviated multiplication and division of decimal fractions, and here took a position far in advance of his time. OUGHTRED practically translated the tenth book of EUCLID into a short symbolism. The other works of OUGHTRED dealt with are his *Circles of Proportion* and his *Trigonometry*. There are also sections on his solution of numerical equations, his treatment of logarithms, his invention of the slide rule about 1622 (he was not the first to publish about slide rules); and his minor works. The article is extremely detailed and valuable. J.

J. M. Child. — The *Lectiones Geometricae* of ISAAC BARROW. *Monist*, vol. XXVI, p. 251-267. April, 1916.

CHILD shows that from certain theorems of BARROW, we can easily deduce : (1) An approximation to the binomial theorem for a fractional index (BARROW never uses such indices, though WALLIS had already done so) and this is all that is necessary to find (2) the tangent to $y = x^{n/r}$, for all positive and negative integral values of n and r. The proofs that BARROW gave were, however, independent of the binomial expansion and therefore of NEWTON. BARROW's great advance on his predecessors is the ability to deal with irrational functions, explicit and, by means of his « differential triangle », implicit as well. He also differentiates tan x. (3) BARROW's proofs that differentiation and integration are inverse, are given. (4) A maximum and minimum proposition is given, either independently of or in anticipation of RICCI to whom it is ascribed. (5) METIUS' ratio 355/113 is found geometrically. (6) WREN is anticipated in the rectification of the cycloid by a general theorem in rectification. The source of BARROW's ideas is hardly FERMAT; and the fluxional methods of NEWTON and BARROW are so similar that they could only have arisen from one idea. The development of NEWTON's method was probably due to the lucky accident that he was removed for a time from BARROW's influence by the outbreak of the plague. J.

Augustus De Morgan. — Essays on the Life and Work of NEWTON. Edited, with Notes and Appendices, by PHILIP E. B. JOURDAIN, XIV+198 p Chicago and London : The Open Court Publ. Cy, 1914.

AUGUSTUS DE MORGAN's biographical sketch entitled « NEWTON » appeared in *The Cabinet Portrait Gallery of British Worthies* in 1846,

and is the first essay printed in that volume. It was, after BAILY's *Life of Flamsteed* of 1835, the first English work in which the weak side of NEWTON's character was made known. Justice to LEIBNIZ, to FLAMSTEED, even to WHISTON, called for this exposure; and the belief that it was necessary did not lower the biographer's estimate of NEWTON's scientific greatness, and of the simplicity and purity of his moral character. FRANCIS BAILY's discovery of the correspondence between the Rev. JOHN FLAMSTEED, the first Astronomer Royal, and ABRAHAM SHARP, as well as between NEWTON, HALLEY, and FLAMSTEED, on the publication of FLAMSTEED's catalogue of stars, had thrown a new light on the character of NEWTON. It appeared that the practical astronomer had been treated ungenerously by NEWTON, who failed to observe the conditions of publication agreed to by all parties; and afterwards, when remonstrated with, omitted the name of FLAMSTEED in places where it had formerly stood in the earlier editions of the *Principia*.

It was not only mathematical discovery and controversy that DE MORGAN treated in the just, broad-minded, and high-minded way that is characteristic of him. He disclaimed any particular interest in those religious beliefs of NEWTON which he discussed so thoroughly; still, he seems to have felt more interest in the question, from its own nature, than he was himself aware of. He said: « Whatever NEWTON's opinions were, they were the result of a love of truth, and of a cautious and deliberate search after it ». That NEWTON was a firm believer in Christianity as a revelation from God is very certain, but whether he held the opinions of the majority of Christians on the points which distinguish Trinitarians from Arians, Socinians, and Humanitarians, is the question of controversy.

The second of DE MORGAN's Essays printed in this volume concerns the great controversy about the invention of the fluxional or infinitesimal calculus, in which NEWTON and LEIBNIZ were the principals. The Essay printed is from the *Companion to the Almanac* of 1852, and and is now extremely rare. It is of great interest and importance both on account of the fairness and vigour which DE MORGAN always showed in the defence of LEIBNIZ against the imputations of NEWTON and the Royal Society, and because it first introduced the English public to GERHARDT's important discovery of LEIBNIZ's manuscripts showing his gradual discovery of the calculus in 1673-1677. This Essay also contains a summary of much of DE MORGAN's historical work on the controversy. Where it seems advisable, notes have been added to the second Essay, giving an account of DE MORGAN's and others' work on the subject.

To this second Essay the editor has added an appendix, the chief

aim of which is to give the sources at which may be found the original manuscripts written by NEWTON and LEIBNIZ when they were discovering their respective calculuses. This has not been done hitherto, and it is all the more necessary that it should be done, as modern authors, such as MORITZ CANTOR in his *Vorlesungen*, neglect the fact that any early manuscripts of NEWTON's on fluxions are extant, or that some have been published — by RIGAUD, for example — and some still remain unpublished.

In 1855 appeared Sir DAVID BREWSTER's *Memoirs of the Life, Writings, and Discoveries of Sir Isaac Newton*, and DE MORGAN, in a critique of this work in the *North British Review*, showed clearly that Sir DAVID had fallen into hero-worship. Here the faults of NEWTON are pointed out with an unwavering finger, and the merits of LEIBNIZ are recognized and his character defended against BREWSTER more at length than in DE MORGAN's biography of NEWTON. This review is printed as the third of DE MORGAN's Essays on NEWTON. The editor has added two appendices to this third Essay : the first is part of a biography of LEIBNIZ which DE MORGAN wrote, and which illustrates a laudatory reference to that great man in the third Essay; the second is an extract from a later work of DE MORGAN's, and deals with NEWTON's character and the relation to it of the Royal Society down to DE MORGAN's own times.

Numerous notes of either a bibliographical, explanatory, or critical nature have been added to all the Essays, but all that is not DE MORGAN's is put in square brackets. Such notes have become necessary, and it is hoped that the present ones will reply to all the calls of necessity and will make the book both useful and complete. Very little has to be criticized in DE MORGAN's history or conclusions. Like everything he wrote, these Essays of his are marked by scrupulous care, sanity of judgment, and wide reading; and one hardly knows which to admire most : the breadth or the height of his mind.

The frontispiece is from an engraving by E. SCRIVEN of VANDERBANK's portrait of NEWTON in the possession of the Royal Society of London. An engraving from this picture accompanied the original of DE MORGAN's biographical sketch ; but the present frontispiece is from a much finer engraving prefixed to the biography of NEWTON in the first volume of *The Gallery of Portraits with Memoirs* of 1833. J.

E. W. Hobson. — JOHN NAPIER and the Invention of Logarithms, 1614, 48 p. A Lecture. Cambridge, University Press 1914.

This lecture was delivered some time before the celebration at Edinburgh in 1914 of the tercentenary of the publication, of JOHN NAPIER's (1550-1617) *Descriptio*, and the book has a reproduction from

an engraving of NAPIER for a frontispiece, and contains a reproduction of one of the pages of tables in the *Descriptio*. The purpose of the lecture is to give a concise account of the conception of a logarithm in the mind of NAPIER, and of the method by which he constructed his table of logarithms. Stress is laid on the fact that NAPIER employed points in motion along straight lines for the purpose of defining his logarithms, whereas STIFEL, BÜRGI, and others had merely considered the relationship between two discrete sets of numbers in arithmetical and geometrical progression respectively. This use of the continuous variable was of great importance in the development of mathematical analysis. The contents of the lecture are as follows : Summary of the life of NAPIER (p. 8-16); Reception of the Canon by contemporary mathematicians (p. 16-18); the contents of the *Descriptio* and of the *Constructio* (p. 18-21); the decimal point, which was introduced by NAPIER (p. 21-23); NAPIER's kinematical definition of a logarithm in the *Descriptio* of 1614 (p. 23-26); the limits of a logarithm (p. 27-28); NAPIER's construction of the Canon as described in the *Constructio* written before 1614 but only published in 1619 (p. 28-38); the accuracy of NAPIER's Canon (p. 38-39); the improved system of logarithms (p. 39-42); other tables (p. 43); predecessors of NAPIER (p. 43-45); a rival inventor, JOBST BÜRGI (p. 46-47); Conclusion (p. 47-48). J.

Philip E. B. Jourdain. — NEWTON's Hypotheses of Ether and of Gravitation from 1672 to 1679. *Monist*, vol. XXV, p. 79-106, January 1915.

The fortunes of NEWTON's views on ether and on the connected question as to whether or no gravitation is an essential property of matter are here traced from his earliest publication up to 1679. Hitherto, writers on mechanics have usually unduly neglected the theories of the ether given in NEWTON's optical papers, and writers on optics have often overlooked the mechanical significance — which was continually emphasized by NEWTON himself — of theories of the ether. Section I contains a sketch of the theories of light and colour due to DESCARTES, HOOKE, and others, and the state of knowledge as to the aberrations of lenses when NEWTON began his work on optics. The second section deals with NEWTON's first optical memoir of 1672; and particular attention is paid to the only mention of the ether in it. Section III deals with the controversy on NEWTON's memoir and especially with HOOKE's attack on NEWTON's corpuscular view of light. As NEWTON himself emphasized, this view was by no means an essential supposition, and « at most a very plausible consequence of the doctrine »; he considered light to be « something or other propagated

every way in straight lines from luminous bodies, and did not determine what that thing is ». In his hypothesis the vibrations of ether are « as useful and as necessary » as in HOOKE's; indeed, here NEWTON admitted an ether as a matter of course, by the side of his corpuscles of light. The fourth section deals with NEWTON's « Hypothesis explaining the Properties of Light » of 1675, which rested on a combination of the emission-theory and the undulatory theory, and was, according to NEWTON, a somewhat hastily written « illustration » of his experiments. This hypothesis is very fully dealt with, and a large part of it is reproduced; and finally an account of the controversy with HOOKE on the « Hypothesis » is given.

Philip E. B. Jourdain. — NEWTON's Hypotheses of Ether and of Gravitation from 1679 to 1693. *Monist*, vol. XXV, p. 234-254, April 1915.

This is a continuation of the foregoing article. The first Section deals with NEWTON's letter of 1679 to ROBERT BOYLE and many extracts from this letter, which contained a fairly full development of NEWTON's hypothesis of 1675, are given. Section II is on the opinion (held by THOMAS YOUNG and others) that NEWTON had a tendency towards the undulatory theory. However, there seems to be no doubt but that NEWTON always preferred, for what then seemed to be the decisive reason of the rectilinear propagation of light, the emission-theory. Section III gives an account of the treatment of the ether and theories of light in the *Principia* of 1687. A particular point, and one that does not seem to have been thoroughly attended to hitherto, is the careful separation of additions made in the editions of 1713 and 1725. Any development of NEWTON's thoughts on the ether does not seem to be expressed in these editions to such an extent as to make it necessary to keep strictly to the chronological order, and deal with the second edition of the *Principia* wholly after the first editions of the *Opticks*. Of course the views of NEWTON's school, and especially of ROGER COTES, the editor of the second edition of the *Principia*, will be dealt with subsequently. But in this section is given in detail extracts from letters which passed between COTES and NEWTON in 1712 on an argument of NEWTON's that there must necessarily be a vacuum. Section IV deals with NEWTON's views as to whether gravity is, like hardness or impenetrability, an essential property of matter, as expressed in the various editions of the *Principia*. The extracts in the third and fourth sections, together with extracts from subsequent works which we shall meet later, illustrate the neutral position towards the question as to the nature of gravitation which NEWTON always tried to maintain in his published work, and emphasized in the second and third editions of the *Principia*. We shall only be concerned with the opinions

expressed by NEWTON's school on this subject when we have finished the examination of all that NEWTON himself has said on it. As we shall see again in the next section, NEWTON strongly inclined towards the belief that the attraction of matter was brought about by the intermediary of an ethereal medium, but he seems to have rightly recognized that the question as to whether this attraction is, like hardness or impenetrability, an essential property of matter, or whether a medium is necessary for the action of two bodies on one another had no bearing on the facts about attraction that were mathematically expressed in the *Principia* : it only concerned physical explanations of this attraction. Besides this, it is probable that NEWTON knew only too well that, by indulging in speculations which could not be proved or disproved experimentally, he laid himself open to hated controversy. It is true that he had to meet controversies about the experimental truths he had discovered; but in the midst of his very natural irritation, he must have been conforted by the trought that, in this case at any rate, there was really no question of personal opinion involved. Section V contains a detailed examination of NEWTON's correspondence with RICHARD BENTLEY in 1692 and 1693, in which NEWTON's tendency towards an explanation of attraction by a medium, and the fact that the truths given in the *Principia* are unaffected by the truth or falsity of any such hypothesis, are strongly expressed. Newton's religious tendencies, such as his constant wish to prove the existence of an intelligent creator, came into consideration in the course of this article.

J.

Philip E. B. Jourdain. — NEWTON's Hypotheses of Ether and of Gravitation from 1693 to 1726. *Monist*, vol. XXV, p. 418-440, July 1915.

In the first edition (1704) of the *Opticks* there was no mention, in the « Queries », of ether or gravitation. After a mainly bibliographical section (§ I), in § II are collected those Queries added to the Latin translation of 1706 which have a bearing on the present subject. NEWTON's objections to the undulatory theory are here clearly stated. In chronological order, the next event is the publication of the second edition of the *Principia* in 1713; and to the additions about the ether and the nature of gravitation, together with a discussion of the attitude, which is shown to be other than is generally supposed, of ROGER COTES towards the latter question, § III is devoted. In § IV are considered the relevant additions to the second English edition (1717) of the *Opticks*. The matter of these added Queries is taken from the « Hypothesis » of 1675 and the letter to BOYLE of 1679; whereas the

experimental part of the memoir of 1675 had always formed the basis of the *Opticks*. F. ROSENBERGER (*Isaac Newton und seine physikalischen Principien*, Leipzig, 1895) seems, partly in consequence of this, much too prone to attribute to NEWTON the denial of an ether which was held by some of his school. § V refers to NEWTON's later (1716, 1725) remarks on LEIBNIZ's criticism that he viewed gravitation as an « occult cause » and a « miracle ». § VI deals with NEWTON's opinion on an ether and the nature of gravitation from the general point of view which has been reached. The conclusions are, as might be expected, somewhat different from those of ROSENBERGER : ROSENBERGER's conclusions are not wholly unlikely, but the present author's conclusions are supported by NEWTON's letters to BENTLEY (1692-1693) and LEIBNIZ (1693). J.

Selections from the Scottish Philosophy of Common Sense. Edited by **G. A. Johnston**. — N° 2 of « The Open Court Classics of Science and Philosophy ». VIII+267 pages. Chicago and London, The Open Court Publishing Company, 1915.

This volume consists of extracts from the works of the chief representatives of the Scottish Philosophy of Common Sense. The selections have been made, for the most part, from THOMAS REID's [1710-1796] *Inquiry into the Human Mind on the Principles of Common Sense*, and *Essays* ; but these have been supplemented by important or typical passages from DUGALD STEWART [1753-1828], JAMES BEATTIE [1735-1803], and ADAM FERGUSON [1723-1816]. Most of the selections are metaphysical or psychological, but ethical doctrines have not been neglected. In the introduction an attempt has been made to estimate REID's historical importance in connection with the LOCKE-BERKELEY-HUME development of thought, and in relation to KANT's « answer to HUME ». The Scottish Philosophy contains much that is interesting and valuable, but it has not been readily accessible to the student, partly because the writings of its representatives are prolix to a degree, and partly because their books are not easily obtainable. These facts constitute the sufficient justification of such a volume as this. And at a time when much interest is being taken in New Realism, it may not be out of place that some attention should be paid to the Natural Realism of the Scottish Philosophy. J.

Chas. Tweedie. — A study of the Life and Writings of COLIN MACLAURIN. *Math gaz.*, vol. VIII, p. 133-151. October, 1915.

In this article, which is illustrated by a portrait of COLIN MACLAURIN (1698-1746), professor of mathematics at the Universities of Aberdeen

and Edinburgh in succession, and some other reproductions of photographs, there is first an excellent biographical sketch and then an account of MACLAURIN's published works. Among these, MACLAURIN's first contributions to mathematical literature deal with geometry and began in 1718. His memoirs of 1718 and 1719 were incorporated and amplified in his famous *Geometria Organica* of 1720, of which TWEEDIE gives a fairly detailed account. In this treatise curves of all orders are described by the use of constant given angles and fixed straight lines, and then his methods are generalized. The chapter on Pedals is one of the most interesting in the book, though it has been much neglected.

TWEEDIE then gives an account of the « BRAIBENRIDGE-MACLAURIN Theorem », which was published by W. BRAIKENRIDGE in 1733, and which had apparently been long previously discovered by MACLAURIN and used in his lectures since 1727. To this theorem and the controversy which arose out of it, the next paragraphs of TWEEDIE's paper are devoted. The full memoir, *De Linearum Geometricarum Proprietatibus Generalibus Tractatus*, appeared as an appendrix to MACLAURIN's *Treatise of Algebra*, published in 1748 after MACLAURIN's death, and is of the first importance in the theory of higher plane curves. TWEEDIE gives very much slighter accounts of the *Treatise of Fluxions*, of 1742, the development of a pamphlet that MACLAURIN had intended to publish in reply to BERKELEY's *Analyst* of 1734, and of which much was in proof in 1737. Indeed, he only gives a few samples of MACLAURIN's handiwork in this treatise. Thus we find references to the theorems on the attractions of ellipsoids, which he had discovered in his prize memoir of 1740 on the tides; the deductions of the properties of the ellipse by considering it as an oblique section of a right circular cylinder; the « modern » definition of similar and similarly situated figures; the « Trisectrix of MACLAURIN »; the contributions to the rectification of the ellipse; « MACLAURIN's Theorem » for the expansion of $f(x)$; the theory of the turning values of $y = f(x)$; and the integral test for the convergence or divergence of an infinite series. A short account is also given of the *Algebra*, which is to be read as a commentary on NEWTON's *Arithmetica Universalis* and of *An Account of Sir Isaac Newton's Philosophical Discoveries*, both of which books were published posthumously in 1748. There is an appendix containing a list of MACLAURIN's contributions to the Philosophical Transactions, the Physical and Literary Essays, and of the manuscripts in the possession of the University of Aberdeen.

Finally, there is a short list of works consulted, from which further information may be obtained.

J.

Alexander Macfarlane. — Lectures on Ten British Physicists of the Nineteenth Century (Mathematical Monographs, No. 20, 144 p.). New York, JOHN WILEY and Sons; London, CHAPMAN and HALL, 1919.

During the years 1901-1904, ALEX. MACFARLANE (Blairgowie, Scotland, 1851-Chatham, Ontario, 1913), delivered at Lehigh University, South Bethlehem, Pennsylvania, lectures on 25 British mathematicians of the nineteenth century. Ten of these lectures have already been published in *Monograph*, No. 17 « Ten British Mathematicians ». — They were devoted to: GEORGE PEACOCK; AUG. DE MORGAN; Sir WILL. ROWAN HAMILTON; GEORGE BOOLE; ARTHUR CAYLEY; WILL. KINGDON CLIFFORD; HENRY JOHN STEPHEN SMITH; JAMES JOSEPH SYLVESTER; THO. PENYNGTON KIRKMAN; ISAAC TODHUNTER. Ten more, now published, are devoted to mathematicians whose main work was in physics, astronomy and engineering, to wit: JAMES CLERK MAXWELL; W. J. M. RANKINE; P. G. TAIT; KELVIN; CHARLES BABBAGE; WILL. WHEWELL; Sir GEORGE G. STOKES; Sir GEORGE B. AIRY; J. C. ADAMS; Sir JOHN F. W. HERSCHEL. There is an index (not carefully made!) and a plate with ten small portraits.

This book is very interesting, but much less than it could have been. MACFARLANE'S idea was to give in each lecture a sketch of a great scientist. We do not expect a sketch to replace a more complete biography, but we would expect the lecturer to lay more stress on the work upon which the fame of each man was based. We find nothing of the kind in these lectures. They are easy to read, but they are not really stimulating, because the essential of each life is not brought out more clearly; they are like paintings without focus and perspective. A few personal reminiscences add here and there a touch of colour, but the style is indifferent. The author must have been a kind and lovable man; he was also very impartial and one can but admire the candor with which he (president of the international association for promoting the study of quaternions!) reproduces (p. 43) KELVIN'S sweeping indictment of the quaternions.

The editors could have increased the value of this book by adding bibliographical notes to each sketch. As it is, the book is neither a work of reference, nor a collection of first hand documents. It must rather be considered as a series of literary essays, with but little literary value. The proofreading was not very carefully done. For inst. I read on p. 57, LIONVILLE for LIOUVILLE, and on p. 91, FONTENALL for FONTENELLE! Yet this book will be useful; I do not know any other of the same kind. It is not bad, but it could easily have been much better

GEORGE SARTON.

Sylvanus Griswold Morley. — The Inscriptions at Copan. Large quarto, XIV+644 p. Washington, Carnegie Institution, 1920.

This is a monumental publication the scope of which is far greater than the title would suggest. It is indeed a fundamental contribution to our knowledge of Maya civilization, and may help us later to date other American civilizations and to establish their correlations. The ruins of Copan are situated in the valley of the Copan river, at the Western end of Honduras, on the Guatemalan border. The first writer to make them known outside of Central America was the American JOHN L. STEPHENS in 1841; the first intensive study (1899-1902) was due to the Englishman ALFRED P. MAUDSLAY. In the meanwhile, a systematic exploration had been undertaken by the Peabody Museum of Harvard University in 1891 was interrupted in 1895 by order of the government of Honduras. Many of the collected materials remained unpublished. It is during this exploration that J. G. OWENS died at Copan in Febr. 1893, a martyr of science. H. G. SPINDEN of the American Museum of Natural History had been making an elaborate study of Maya art which culminated in the publication of « A study of Maya Art, 1913 ». SPINDEN was first to provide certain stylistic criteria which enable one to place Mayan monuments in a chronological sequence. MORLEY's own studies began in 1905; he made seven visits to Copan between 1910-1919 but the main part of his material was collected by him in 1915.

His chief purpose was to decipher the Maya hieroglyphic writing It is interesting to retrace briefly the development of our knowledge of this writing. The basis is the manuscript of Father DIEGO DE LANDA, dated 1566 and now in the R. Academy of History of Madrid. His relation is a veritable « Maya Rosetta stone »; it is based on native knowledge and contains a description of the native calendar, also a Maya alphabet, the latter however, incorrect. The next step was made by ERNST FÖRSTEMANN of Dresden (1887) who worked out the principles of Maya chronology. While his investigations were based on Maya Mss., J. T. GOODMAN of Alameda, California, arrived at similar results independently (1895-1897) by the study of the Maya inscriptions. GOODMAN's preeminence in the field of the inscriptions is beyond question. He was the first to make known the existence of the head-variant numerals, the so-called Maya Arabic notation and to identify their different values, and he devised chronologic tables. There are still two names, which must be mentioned even in the briefest history, — the one of MAUDSLAY who first realized the importance of the Initial Series, and who gave a tremendous impetus to Maya studies by the publication of his accurate copies of the inscriptions, and the other that of D. G. BRINTON, the « Father of Maya history », who was

first to study the native chronicles and to proclaim their trustworthiness, now generally admitted. The investigations of EDUARD SELER of Berlin, CYRUS THOMAS of Washington and C. P. BOWDITCH of Boston are also important and stimulating, but they are perhaps less fundamental.

To return to MORLEY'S work. His present investigation is limited to a study of the chronological data found in the Copan inscriptions, and incidentally in other Maya inscriptions. That may seem at first view a great restriction of the subject but it is not, because chronological data are the only readable data of the inscriptions and about half of the glyphs deal with them (p. 33). « Unlike the inscriptions of every other people of antiquity, the Maya records on stone do not appear to have been concerned — at least primarily — with the exploits of man, such as the achievements of rulers, priests or warriors — in short, with the purely personal phenomena of life; on the contrary, time in its many manifestations was their chief content. The Maya priesthood in whose hands exclusively rested the knowledge of the hieroglyphic writing, conceived time more elaborately than any other people the world has ever known at a corresponding stage of general culture. » It is possible that the undeciphered parts of the Maya inscriptions contain historical data, but these can not be very numerous. MORLEY uses throughout the BOWDITCH system of noting dates and not the German method of stating the total number of days.

For ex. one of the dates will read like this :

9. 15. 0. 0. 0; 4 Ahau 13 Yax

The first part of the date means that from the starting point of the Maya era have elapsed 9 cycles of 144,000 days each, 15 katuns of 7.200 days each, 0 tuns of 360 days each; 0 uinals of 20 days each, and 0 kins, that is odd days. The second part means that when all these days have been counted from the beginning of their chronology the day reached will be 4 Ahau, the 14th (not the 13th!) day of the month Yax. This second part is not necessary to fix the date, but it served to make it more concrete and gives us a method of checking it. From the example quoted it will be noted that one cycle = 20 katun = (20×20) tuns (or approximately years) = $(20 \times 20 \times 18)$ uinals.

The earliest dated inscription extant is on the Tuxtla Statuette found about 1902 near San Andres Tuxtla in the State of Vera Cruz, Mexico, that is outside the Maya territory. It bears the date 8. 6. 2. 4 17. There are only two other inscriptions relating to the eighth cycle, and the earliest of them, the Leyden plate is some 160 years younger.

A long appendice is devoted to the correlation of Maya and Christian

chronology, a subject on which the archaeologists disagree as widely as possible. To the Maya date 9. 0. 0. 0. 0. correspond the following Christian dates according to the authors named: JOYCE, 95 B. C.; BOWDITCH, 94 B. C.; SPINDEN and MORLEY, 176 A. D.; GOODMAN, 435; LEHMANN, ca. 700; SELER, ca. 1.007; FÖRSTEMANN, 1134. There is a maximum divergence of more than twelve centuries! MORLEY believes that his own correlation is probably correct to within 4 months and possibly to within 49 days. All these chronological attempts are established on the same basis, that is the *u Kahlay Katunob*, native Maya chronologies the compilation of which did not begin before 1.575 A. D. The *u Kahlay Katunob* give us the only bridge between the Maya inscriptions and Christian chronology and the divergence of the final results are due to the several interpretations placed upon this bridge. I can not go into the technical details of MORLEY's investigations but will quote here his final results. The principal divisions of Maya history are as follows:

The Old Empire. — (I) The Early Period. From the beginning to 374 A. D.; (II) The Middle Period. 374 to 472 A. D.; (III) The Great Period, 472 to 610 A. D. That is, the Old Empire lasted from about the time of Christ to the beginning of the VIIth century.

The New Empire. — (IV) The Colonization Period. 453 to 689 A. D. (partly coeval with periods II and III); (V) The Transitional Period. 689 to 985 A. D.; (VI) The Renaissance Period. 985 to 1202 A. D.; (VII) The Toltec Period. 1202 to 1458 A. D.; (VIII) The Final Period. 1458 to 1542 A. D.

With the many illustrations of MORLEY's book and those previously published by MAUDSLAY and the Peabody Museum practically all the Copan inscriptions are now accessible. This was the more necessary that these monuments being situated in a volcanic country are liable to be irreparably destroyed at any time. As a matter of fact many of those here reproduced have been destroyed within the last four years. I may add that the Copan inscriptions form about 40 per cent of the *Corpus Inscriptionum Mayarum*, and cover a chronological range of 335 years, or the greater part of the Old Empire.

In this review I have systematically avoided the more technical parts of MORLEY's investigations, yet I must quote at least two of his achievements, that is his discovery of the hieroglyph for the five years periods which became of great importance to the ancient Maya, and his interpretation of the so-called Supplementary Series, as a lunar calendar embodying certain eclipse data. He has also taken pains to sum up all what we know of Copan and Maya history, illustrating his account with many diagrams and tables. — The Carnegie Institution deserves warm praise for the splendid presentation of this great work.

G. S.

Dr Appert. — L'Hérédité morbide. (Bibl. de Philos. scientif.), 306 p., 185×117; Paris, FLAMMARION, 1919. [5.75 Fr.]

Examen des tares que déterminent l'alcoolisme, la tuberculose, la syphilis, le cancer, les infections des glandes endocrines, etc. — tares qui sont *normalement* héréditaires —, et de quelques moyens de nature à permettre d'éviter la déchéance progressive qui peut s'en suivre pour la race, et à laquelle l'auteur ne croit d'ailleurs pas. Parmi les moyens préconisés pour lutter contre cette hérédité, M. APPERT retient ceux qui peuvent entraver la reproduction des individus tarés : stérilisation des aliénés, des criminels, etc., réglementation du mariage, admission par la loi du divorce dans les cas de maladie héréditaire d'un des conjoints. Il recommande également des mesures de protection de la femme enceinte, de la nourrice, de la première enfance, et l'intensification de la lutte contre les trois grands fléaux sociaux : alcoolisme, syphilis, tuberculose. L. GUINET.

Blaringhem, L. — Les problèmes de l'Hérédité expérimentale. (Bibl. de Philos. scientif.), 317 p., 185×117. Paris, FLAMMARION, 1919. [5.75 Fr.]

Les faits sur lesquels repose cet exposé critique et synthétique des problèmes de l'hérédité expérimentale sont tous tirés du domaine de la botanique, et pour une bonne part, des recherches personnelles très remarquables poursuivies par l'auteur depuis plus de quinze ans sur les céréales en particulier.

Sont successivement definies avec précision et étudiées dans le détail : l'hérédité normale : lignées pures et hérédité fluctuante (QUÉTELET, GALTON, PEARSON, DAVENPORT); les hybrides d'espèces, hérédité mixte avec ses formes exceptionnelles : hérédité en mosaïque (NAUDIN, BLARINGHEM [orges]), hérédité unilatérale (MILLARDET, et SOMS-LAUBACH [fraisier], LIDFORSS [ronces, etc.]), théorie de la coalescence des plasmas (ARM. GAUTIER); l'hérédité mendélienne, ou alternante. A ce dernier sujet, l'auteur met très justement en garde contre l'extension de la notion de facteurs à l'analyse de caractères qui ne comportent pas de discontinuité.

Mais c'est dans les conclusions de B. qui se trouve la partie la plus originale du livre, et dont trois courtes phrases donneront une idée nette : « Il n'est donc pas sans intérêt de comparer les phénomènes de l'hérédité aux faits étudiés en physique et en chimie. Les lois de l'équilibre sont évidemment les mêmes dans ces différents ordres de sciences, et il est probable que des rapprochements entre leurs applications mettront en évidence des analogies utiles pour leur perfectionnement réciproque. » — « L'étude de l'hérédité normale se ramène à celle des

concentrations et des dissolutions d'un système en équilibre. » — « La crise sexuelle est donc une crise de dissociation moléculaire. » On voit quelles sont les directives qui animent B., et qui doivent, selon lui, guider les expérimentateurs dans le domaine de la biologie générale. Elles n'ont jamais été, dans le chapitre de l'hérédité tout au moins, affirmées avec une telle foi. L. GUINET.

Guilleminot, H. — La Matière et la Vie. (Bibl. de Philos. Scientif.), 318 p., 185×117; Paris, FLAMMARION, 1919. [5.75 Fr.]

Très noble essai de vulgarisation d'une hypothèse intéressante, mais qui n'est qu'une hypothèse, à laquelle l'auteur donne le nom de *loi d'option vitale*, déjà proposée par lui dans *Les Nouveaux horizons de la science*, et qui serait capable de faire tomber le voile qui recouvre le problème de la finalité suprême, et « d'apporter à l'homme des enseignements qui l'éclairent sur l'utilité de son labeur et sur la grandeur du but poursuivi ».

Après avoir étudié la loi de conservation de l'énergie et celle de la dégradation de l'énergie, et constaté que le principe de CARNOT qui régit la matière inerte, est incapable de rendre compte des progrès de la matière vivante, M. GUILLEMINOT propose une loi propre aux êtres vivants, particulière à l'irritabilité de la matière, la loi d'option vitale, dont « la spontanéité des êtres animés, l'impulsion instinctive des animaux supérieurs, les facteurs de volition de l'homme, y compris le sens moral, » ne sont qu'une manifestation subjective. — Qu'est cette loi d'option vitale qui, se surajoutant au principe de dégradation de l'énergie, justifie les progrès de la matière vivante à travers ses formes successives?

L'option vitale est le choix entre toutes les routes offertes par la deuxième loi de l'énergétique à l'évolution des phénomènes de la matière vivante (le terme évolution s'applique ici simplement à l'individu qui vieillit); elle est le choix entre plusieurs phénomènes possibles, tous dégradateurs de l'énergie et s'excluant les uns les autres. Entre plusieurs chemins possibles, la nature se comporte comme si elle conservait la mémoire des chemins déjà suivis; c'est ce choix dirigé qui constitue l'option vitale. Or, cette option n'est pas dirigée dans un sens quelconque; la direction est, pour l'auteur, uniforme au point de pouvoir être érigée en loi; la loi d'option est la loi suivant laquelle s'accomplissent les phénomènes de la vie chimique ou de la vie de relation, au milieu de l'indifférence dégradatrice par rapport à d'autres phénomènes également possibles.

Cette option, qui est donc réductible à une manifestation de l'irritabilité, à la répétition du déjà fait, est la négation du principe vital souvent encore admis et dirigeant l'évolution de la matière organique.

Dès lors, la loi morale n'est plus qu'un aspect suggestif de la loi d'option, et il est nécessaire de faire entrer délibérément l'étude du sens moral, des directives de la conduite humaine dans le domaine de la Biologie, ce que fait l'auteur qui termine son livre par l'examen de deux problèmes de sociologie : celui de la culture du sens moral à l'école et celui de la culture des qualités morales dans les foules, par l'orientation des lois économiques et sociales. L. GUINET.

Harvey-Gibson, R. J. — *Outlines of the History of Botany*, in-8°, x + 274 p. London, BLACK, 1919. [12/6]

Prof. HARVEY-GIBSON has written what is unquestionably the most satisfactory general history of Botany for students. The story that he has to tell is simply and attractively told with no needless display of erudition and yet bearing full evidence of direct appeal to the sources. He has elected to pass rapidly over the early stages and of the 274 pages only 50 are allotted to the period before LINNAEUS.

There is much to be said for this method. Not only does the later period seem most likely to appeal to the ordinary student, but also it is that which the professed botanist is himself best qualified to treat, for his training seldom equips him with the special historical methods needed for research in the earlier period. It may moreover be justly claimed that the further we go back in history the more unlike is the grouping of knowledge, especially of scientific knowledge, to that to which we are accustomed and that therefore the method of writing histories of special sciences, as though they existed from the beginning of time, is based on an initial fallacy. It is an avenue of approach which is doubtless necessary in certain cases, but it is one which is distasteful to the philosophical historian of science who attempts to represent the history of knowledge in the manner in which it actually grew. From this point of view there is comparatively little history of botany, as such, before the XVIIth century since its course was previously largely merged with medicine. We think therefore that Prof. HARVEY-GIBSON has done well to limit his field of labours and within that field he has attained a result that appears to us wholly admirable.

We would however make certain reflections on the author's historical principles which in no way touch the book as a whole but which make us regret that the first 50 pages of the book have been included in so excellent a study.

Firstly the author fills much of this very limited space in pointing out short-comings in the work of JULIUS VON SACHS. Some years ago the late E. L. GREENE exhausted himself and his readers and turned

a good piece of work into a weary wilderness of words by his determined invective against the errors of his predecessors and especially of the great « Würzburg professor ». That those errors exist and that generations of students have imbibed them it is not our purpose to deny. But neither E. L. GREENE nor Prof. HARVEY-GIBSON, excellent historians though they are, seem to have realized that the History of Science is itself a science, a study with its own modes of research, needing its own special training and having its own technique. The state of knowledge of such a subject is therefore always susceptible of improvement and both the material and the presentment of it need constant revision, nor, considering the rate of growth of historical knowledge, is it at all remarkable that the work of SACHS, given to the press in 1875, should need correction in 1920. The error of both of SACHS' critics is to suppose that absolute truth is more attainable in the History of Science than in Science itself.

But as it appears to us there is another flaw in the historical methods of these distinguished historians from which SACHS himself escaped. That writer frankly called his work a *History of Botany, 1530-1860*, he made almost no profession of penetrating behind the earlier date. He did not write that « after GALEN follows an absolute blank; for more than fourteen centuries botany has no history », although he had perhaps not heard of the JULIA ANICIA Manuscript of the VI^th^ century, which has only lately been rendered accessible in facsimile and contains the most beautiful and accurate figures of certain plants that were produced until well beyond the dawn of the XVIII^th^ century. Has Prof. HARVEY-GIBSON studied the scores of beautiful manuscript herbals which contain some of the most striking and characteristic specimens of mediaeval art? Or has he dipped into the pages of ALBERT OF COLOGNE'S, *De vegetabilibus*, sections of which are readily available in MEYER'S monumental *Geschichte der Botanik*? It is clear that he has avoided such aspects of the thought of those difficult and troublesome centuries which lie between the II^nd^ and the XVI^th^ and for his purpose he has rightly avoided them. But to use LEE GREENE'S favourite phrase « it is propagating fable in place of history » to affirm that the human mind, did not act for 1,400 years. During those years the state of science was no doubt dark and dismal and certainly botany degenerated along with other sciences and together with arts and laws, but it is no more true to say that those centuries present us with nothing in the history of laws and arts than it is to say that in them science was not.

The historian of science can no more afford to pass over these centuries of decay than the historian of states can neglect the periods of political dissolution, or the historian of vegetable and animal life the

multitude of degenerate and deteriorate forms in the groups with which he has to deal. The great lesson of history is the continuity of the human mind and the work that does not seek to deal with events as continuous is not history even though it treat of antiquity.

The truth is that nearly all works of science are accounted of little worth by the following generation. Thirty short years is a long life for a scientific treatise and fortunate indeed is the author of that work the leaves of which his grandson will care to turn. It is rightt hat this should be so and it is the scientist's part to maintain the growing edge of active advance on the dead mass of irrelevant and imperfect observation and outworn and untenable hypothesis. But yet the living is in an ecological relation with the dead that it would be death to disturb. Well might the historian of science place at the head of his work the ancient epitaph :

> Reader, thou that passest by,
> As thou art so once was I,
> As I am so shalt thou be,
> Wherefore, reader, pray for me!

Prof. HARVEY-GIBSON has given us a valuable, sincere, and reliable piece of work for which every biological teacher should be grateful, but we hope that in future editions he will remove these strictures on his predecessors and delete the suggestion, specially dangerous in a book intended for students, that any period of history can be summed up without study. CHARLES SINGER.

Berthold Laufer. — Sino-Iranica. Chinese contributions to the History of Civilization in Ancient Iran. With special reference to the history of cultivated plants and products. Field Museum of Natural History, Anthropological Series, vol. XV, p. 185-630. Chicago, 1919.

There can be no greater pleasure for a reviewer than to welcome a book like this, which he can admire and praise almost without restriction. LAUFER's new book is a fundamental contribution not simply to the history of botany but as well to the history of Eastern civilization. To appreciate its full value it will suffice to remember that for the history of cultivated plants, we were entirely dependent upon the works of A. DE CANDOLLE, HEHN and CHARLES JORET (Paris, 1897-1904), admirable works to be sure, but unable to give us much information on the Asiatic migrations of plants For example, DE CANDOLLE's information on Chinese plants was entirely derived from BRETSCHNEIDER's Study and value of Chinese botanical works (Chinese Recorder 1871-1881) which, says LAUFER, « teems with misunderstan-

dings and errors ». Now LAUFER comes in offering us large and important material based upon a first hand study of Chinese and other oriental sources.

The special problem which he set himself to solve was to determine on the basis of Chinese tradition, which plants were introduced by them from Iran and cultivated in their own country, also which other plants of Iran, cultivated or wild, were noticed and described by Chinese authors, finally which drugs and aromatics of vegetable origin were imported from Iran to China. Such a study is specially important because plant migrations are inconceivable without other cultural exchanges. LAUFER's studies — the present one and others which are forthcoming — will thus enable us to measure the Iranian stratum in the structure of Chinese civilization. This is the more important that the Iranians were « the great mediators between the West and the East, conveying the heritage of Hellenistic ideas to central and eastern Asia and transmitting valuable plants and goods of China to the Mediterranean area ». — Iranian literature gives one but little botanical information. LAUFER reproduces (p. 192-194) an interesting disquisition on plants extracted from the Būndahishn (chap. 27) which proves that the ancient Persians were interested in botany, — but no other botanical text of theirs has come down to us. He has also used the *Materia Medica* written about A. D. 970 by ABŪ MANSŪR MUWAFFAQ BEN 'ALÎ of Herat. (By the way this is not only the earliest Persian work on the subject, but the oldest extant New-Persian prose. The MS. dated Jan. 1056 from which this text was published is also the oldest extant Persian MS.). However LAUFER's more important sources by far are Chinese sources. Happily Chinese scholars soon developed a rational and fixed method in there production of foreignwords, so that « in almost every instance it is possible to restore with a high degree of certainty the original Iranian forms from which the Chinese transcriptions evere accurately made ». I cannot insist on this, but I have said enough to suggest that LAUFER's studies are of supreme interest also for the philologist and more especially the Oriental phonologist.

We are more interested in the significance of LAUFER's work from the point of view of the history of civilization. Let us listen again to the author (p. 189): « Stress is laid on the point that the Chinese furnish us with immensely useful material for elaborating a history of cultivated plants... The Chinese merit our admiration for their far-sighted economic policy in making so many useful foreign plants tributary to themselves and amalgamating them with their sound system of agriculture. The Chinese were thinking, sensible, and broad-minded people, and never declined to accept gratefully whatever

good things foreigners had to offer. In plant-economy they are the foremost masters in the world, and China presents a unique spectacle in that all useful plants of the universe are cultivated there ». — The two first foreign plants introduced in China were two plants of Iranian origin, the alfalfa and the grape-vine. This occurred in the latter part of the second century B. C. A great number of other plants followed, originating most of them from Iran and Central Asia, but also from other parts of the world. LAUFER lays stress on the point that the Iranian plant migrations extend over a period of a millennium and a half. In other words, he takes pains throughout his book to destroy the legend according to which, most of these Iranian plants were acclimatized in China during the Han period, thanks to the efforts of the famous general CHANG K'IEN. It is only for the two plants named above that positive evidence permits to give credit for their importation to CHANG K'IEN. For a few other plants, one has no better evidence than that supplied by the *Ts'i min yao shu*, a VI[th] century book, which we know only in a very corrupted state.

LAUFER has used all the Chinese and Japanese *Pen ts'ao* (herbals) available, also Japanese botanical works. He also studied some early Chinese medical books, chiefly those of CHANG CHUNG-KING, or CHANG KI, a second century physician. Unfortunately these books have suffered from various interpolations which it is now impossible to unravel. Apropos of this, LAUFER remarks (p. 205): « A critical bibliography of early Chinese medical literature is an earnest desideratum. » To the information gathered from Chinese and Iranian sources, which form the substance of his volume, LAUFER has added all that was pertinent in the classical, Semitic and Indian traditions.

His book is built in the following way. After a short introduction (24 p.) follow a series of chapters, each of which is a monograph devoted to one or more plants, to wit: alfalfa; grape-vine; pistacchio; walnut; pomegranate; sesame and flax; coriander; cucumber; chive, onion and shallot; garden pea and broad pea; saffron and turmeric; safflower; jasmine; henna; balsam-poplar; manna; asafoetida; galbanum; oak-galls; indigo; rice; pepper; sugar; myrobalan; « gold peach »; fu-tse; brassica; cummin; date-palm; spinach; sugar beet and lettuce; ricinus; almond; fig; olive; cassia pods and carob; narcissus; balm of gilead; water melon; fenugreek; nux-vomica; carrot; aromatics. To this encyclopaedia of Chinese botany are added a few other notes of philological or historical interest, to wit: The Malayan Po-se and its products (Po-se in Chinese denotes two countries, a certain Malayan country, also Persia, for ex. the date is called *Po-se tsao, i.e.* Persian jujube); Persian textiles;

Iranian minerals, metals and precious stones; Titles of the Sasanian government; Irano-sinica, (miscell.); Iranian elements in Mongol; Chinese elements in Turki; Indian elements in the Persian pharmacology of ABU MANSUR MUWAFFAQ (that is the important tenth century work quoted above; it is partly based on Indian knowledge: the author says himself that he had been travelling in India); the Basil; additional notes on loan words in Tibetan.

This encyclopaedia is fittingly completed by very elaborate indexes: a general index which contains also additional information; a botanical index and *thirty* indexes (one for each language!) of the words quoted, including those reconstructed on the basis of Chinese transcriptions. The only criticism which I make bold to suggest concerns the transliteration of Chinese names. BERTHOLD LAUFER introduces here a new system. Whatever the merit of his system be, I believe that individual initiatives of this kind can but increase the present confusion. Indeed, a satisfactory and universal system of transliteration is one of the most urgent needs of the Republic of Letters; but such need can only be fulfilled by an international understanding.

GEORGE SARTON.

Edmund O. von Lippmann. — Entstehung und Ausbreitung der Alchemie. Mit einem Anhange: Zur älteren Geschichte der Metalle. Ein Beitrag zur Kulturgeschichte, gr. in-8° XVI + 742 p. Berlin, JULIUS SPRINGER, 1919.

Some twenty years ago, Dr. VON LIPPMANN to whom we owe already many important contributions to the history of science and chiefly to the history of chemistry, began to accumulate materials for the solution of the following problems: « when did the belief in the artificial production of Gold and Silver originate? which circumstances favoured the growth of this superstition and how did it develop? » The more he advanced in his study, examining in each case as far as was in his power the original documents, the more did the whole subject become complex. Yet he managed to master and to clarify and classify the immense amount of data which he had gathered and the results of his long studies are now offered to the public. Truly a monumental work, the greatest single addition to our knowledge of ancient chemistry — (and also to our knowledge of human superstition) — since the days of KOPP. This work fills in an important gap in our historical literature, for since the publication of KOPP'S book — I am thinking now chiefly of his « Die Alchemie in älterer und neuerer Zeit », Heidelberg 1886 — many new fundamental data have been brought to light. BERTHELOT'S work is also partly out of date. By the way, VON LIPPMANN, while admiring greatly the activity of his great French predecessor,

has been able to point out in the latter's books many errors and inaccurracies : these are shown repeatedly in the course of his own exposition and also in an appendix « BERTHELOT als Historiker », p. 645-658.

Prof. VON LIPPMANN'S book is so overwhelming, that it is not more possible to analyze it in any detailed way than to analyze an encyclopaedia and the best that I can do is to lay bare its general structure, with a few additional remarks here and there.

Let us first remark that the work is devoted not to a complete history of alchemy — (of course a complete history is impossible because human folly is inexhaustible) but simply to a study of its origins and diffusion. It would be very interesting indeed to make a survey of the alchemic and astrologic superstitions which are still thriving in our own enlightened age — they are bound to reappear at the surface now and then, as much as any other forms of ignorance and folly — but that is outside the scope of LIPPMANN'S present undertaking. He does not do more than to allude to it, giving however some precious bibliographical hints (p. 512-513). Another preliminary remark is that the subjects of alchemy and astrology are so intimately connected that LIPPMANN'S book will be of great use to the student of astronomical fallacies.

This encyclopaedia of alchemy is divided into six main parts, as follows (I give for each part the number of pages devoted to it) : 1. Remains of ancient alchemic literature (117); 2. Sources of alchemic theory (143); 3. Chemistry and Alchemy (91); 4. Alchemy in the East (107); 5. Alchemy in the West (55); 6. Ancient history of metals (130). Then follow two appendixes — one on BERTHELOT, the other devoted to addenda and errata, many of which were suggested by scholars who read the proofs (G. JACOB; R. REITZENSTEIN; J. RUSKA, etc.). Elaborate indexes complete the monument.

Let us now describe briefly the contents of each part. An adequate analysis would soon assume an inordinate length; I will give just enough information to enable those who have already some knowledge of the subject to follow the trend of LIPPMANN'S investigations and to understand his method of approach. The first part, *Remains of alchemic literature*, contains first a study of the Leiden and Stockholm papyri, third century digests of much older technical traditions. Then follow seven chapters dealing with the early alchemic writers. The available records enable the historian to retrace an almost continuous evolution extending from the beginning of our era down to the conquest of Egypt by the Arabs in 640-643. For the first centuries, we have the writings of a series of a pseudepigraphists : HERMES, AGATHODAIMON, ISIS, CHIMES, OSTANES, PETESIS, JAMBLICHOS, MOSES, JOHANNES. — PSEUDODEMOCRITOS, PAMMENES, MARIA, CLEOPATRA, COMA-

RIOS lived probably in the first or second century; AFRICANOS, ZOSIMOS and the author of the Papyrus KENYON in the third; PELAGIOS, PIBÉCHIOS, HELIODOROS and SYNESIOS in the fourth; OLYMPIODOROS in the fifth; « Philosophus Christianus » in the sixth or seventh. Like many other Egyptian traditions, these alchemic theories found an echo in later Byzantine literature: STEPHANOS of Alexandria (VII); HERAKLIOS (VII?) and JUSTINIANUS; « Philosophus anonymus » (VII or VIII?); PAPPOS (ID.); COSMAS (ID.); THEOPHRASTOS CHRISTIANOS (VIII or IX); SALMANAS (IX or X); PSELLOS (XI); NICEPHOROS. — A last chapter contains a study of various technical treatises and recipes dating from the eighth to the XIII^th^ and even XIV^th^ century: the only literary remains of the technical tradition which developed while the various Greek, Egyptian and Byzantine authors quoted above concocted their alchemic, mystic and magic doctrines. The technical recipes are written mostly in barbaric Greek in which many Latin, Arabic and Persian words occur. LIPPMANN has added to this chapter a Greek glossary of technical terms (p. 115-117).

The second part, *Sources of alchemic theories* is subdivided as follows: 1. Greek philosophy from THALES to OLYMPIODOROS the Younger, that is from about 600 B. C. to 600 A. D.; an evolution of twelve centuries; 2. Babylonian and Iranian influences; Influences from ancient Egypt and ancient Greece; 3. Hellenistic period (Alexandrine syncreticism): stoic philosophy, astrology (elaborate account based chiefly on BOUCHÉ-LECLERQ and on the investigations of BOLL's school), Hermetism; Gnosticism; Mithraism; Sabianism; Mandaeism.

The third part, *Chemistry and Alchemy*, is partly a synthesis of the information previously analyzed, but it contains also a great deal of new material. Its aim is to retrace the empirical and doctrinal origins of both chemistry and alchemy: 1. Arts and crafts in Egypt; 2. Beginnings of alchemy; 3-4. First mentions of chemistry and of its name. Very minute discussion of this old topic; 5. Origin of alchemic notions, representations, dogmas and names; 6. Remarks about some of the alchemists already studied in the first part: PSEUDODEMOCRITOS, OSTANES, ISIS, ZOSIMOS, PIBÉCHIOS. End of 6 and 7. Terminology, signs and symbols of the Greek alchemists.

The fourth part, *Alchemy in the East*, is not based as the preceding ones were, on a direct study of the original documents because of the author's ignorance of Oriental languages, but he has read translations of the originals whenever available and has been helped by Orientalists, chiefly by the Arabic scholar, JULIUS RUSKA. He has taken pains to insure consistency in the transliteration of proper names; yet it is unfortunate that most diacritical marks are missing. This part opens with an account of the first Arabic translations and writings:

Book of CRATES, VII^th (?) cent. translation of a Greek original which is lost; Book of ALHABIB; Book of OSTANES; Conversations of MARCOS; JÁBIR B. HAYYÁN (VIII), the GEBER of European writers. Then follow: 2. The « Tracts of the Brethren of Purity » (X), Rasá' ilu Ikhwán al Ṣafá, on the basis of Dieterici's translation and studies; 3. The so-called Lapidary of ARISTOTLE, published by RUSKA 1912 (see *Isis*, I, 266); that is a IX^th century work of Syrio persian origin; 4. Syriac writings (a special section being devoted to the Syriac « causa causarum ») (XI-XII); 5. Later Arabic writings: about 67 authors ranging from the VIII^th to the XVI^th century being dealt with. This story might have been easily carried on down to our own days, because alchemic superstition is still rampant in the Mohammedan world. — but that would be of very little use because the modern and ancient superstitions are essentially alike; 6. Alchemy in India and Tibet (based chiefly on THIBAUT, P. CH. RAY, DEUSSEN); 7. Alchemy in China (GRUBE, HUEBOTTER, HANBURY, etc.).

The fifth part, *Alchemy in the West* is subdivided in two main sections by the year 1300. The second section — alchemy after 1300 — is treated in a more superficial way, inasmuch as the many visionaries and swindlers of the Renaissance and of later times did not really improve the elaboration of alchemic doctrines. In the first section, LIPPMANN examines successively the following topics: *a*) ***Compositiones ad tingenda musiva...*** (VIII); *b*) ***Mappae clavicula de efficiendo auro...*** (about 800); *c*) HERACLIUS, author of a book on the colours and arts of the Romans, the first and second parts of which go back to the X^th century, while the third part dates of the XII^th or XIII^th; *d*) THEOPHILI ***schedula diversarum artium*** (about 1100); *e*) MARCUS GRAECUS (VIII or IX, in its present form not earlier than 1250); *f*) period of Latin translations. Pseudepigraphists: Pseudo-GEBER, Pseudo-AVICENNA, Pseudo-RAZI, etc.; *g*) Encyclopaedists of the XIII^th century.

The sixth and last part, is not really a part of the general structure but an annex. It is a synthesis of a different kind. The author has collected here for each of twelve metals its ancient history, chiefly from the alchemic point of view.

The completion of this monumental undertaking amidst the tragedies of the last years is a credit to the author and publisher. It is indeed an admirable work, well informed, well built, clearly written, copiously indexed. Of course the absolute value of a work of this size cannot be quickly estimated; it can only be appreciated after a long and intimate acquaintance. There is every reason to believe however that LIPPMANN's *magnum opus* will bear the test of time successfully.

GEORGE SARTON.

Edmond Goblot. — Traité de Logique. Préface de M. Emile Boutroux. xxiii+412 p. Paris, Armand Colin, 1918.

Ce nouveau *Traité de Logique* mérite d'être brièvement analysé dans *Isis* non seulement à cause de son importance intrinsèque, mais aussi à cause du parti que l'auteur a tiré de l'étude de la pensée scientifique. Il s'est efforcé de construire une logique qui soit vraiment féconde, et et il a très clairement vu que le seul moyen de réussir était de faire appel à l'expérience logique de l'humanité. Il y insiste souvent : « Il est bon d'étudier ce que font, ce que disent et ce que pensent les savants ; le logicien n'a point qualité pour les régenter ; il doit au contraire se mettre à leur école et s'asseoir humblement sur le banc des étudiants. » Un pareil traité de logique est aussi dans une certaine mesure un traité de psychologie, — une analyse de l'intelligence —, mais à vrai dire dès qu'on sort du cadre étroit de la logique formelle, les frontières de la logique deviennent très difficiles à déterminer. L'effort original d'Edmond Goblot est digne des plus grands éloges. Notre seul reproche c'est qu'il n'ait pas fait un appel plus large encore à l'expérience du passé. L'histoire de la science est une véritable mine d'expériences logiques, une mine qui est encore dans une large mesure inexplorée. Il est extraordinaire aussi que l'auteur n'ait point cru devoir tirer parti des travaux si suggestifs d'Ernst Mach.

Les idées fondamentales de ce livre sont les suivantes : Le raisonnement n'est pas essentiellement une analyse ; il doit sa fécondité à des opérations constructives (choix, rapprochement, combinaison, synthèse) ; il doit sa nécessité à ce que toutes ces opérations sont exécutées en vertu de règles ; ces règles ne sont pas les règles de la logique, mais les propositions antérieurement admises ; le rôle du syllogisme se borne à l'application de ces règles au cas considéré. Le syllogisme hypothétique est seul fécond, le syllogisme catégorique étant nécessairement tautologique. Il est impossible de concevoir un raisonnement indépendant des objets sur lesquels on raisonne.

Ce traité ne s'occupe aucunement des questions qui ressortissent à l'algèbre de la logique et à la logistique. Il ouvre une voie nouvelle, l'élaboration d'une logique expérimentale et constructive, synthétique. Il nous donne beaucoup à penser et à espérer. Car comme le rappelle Boutroux dans sa préface, la raison est susceptible de culture et de progrès. Notre logique évolue, et c'est surtout le progrès des sciences qui la fait évoluer.

Après avoir entrepris des études médicales, poursuivies pendant quatre ans, Edmond Goblot changea son dessein et devint docteur ès lettres. Sa thèse de doctorat, *Essai sur la classification des sciences* (Alcan, 1898) contient déjà le germe des idées directrices de sa logique.

On lui doit aussi un *Vocabulaire Philosophique* (Paris, COLIN) et *Justice et Liberté* (ALCAN, 1904; 2e éd., 1907). Il est professeur d'histoire de la philosophie *et des sciences* à l'Université de Lyon et correspondant de l'Institut. GEORGE SARTON.

M. J. M. Hill. — The Theory of Proportion, xx+108 p. London, CONSTABLE and Cº., Ltd., 1914.

HILL maintains that a treatment of the theory of proportion, which is valid when the magnitudes concerned are incommensurable, should be included in the mathematical curriculum. He has arrived at the conclusion that, in addition to the difficulties arising out of EUCLID's notation and out of the fact that EUCLID did not sufficiently define ratio, two reasons could be assigned for the great difficulty, of this argument: (1) Of the many definitions prefixed to the fifth Book, the only ones which effectively count are the fifth, the test for deciding when two ratios are equal, and the seventh, the test for distinguishing between unequal ratios. EUCLID has the logically unnecessary practice of deducing some of the properties of equal ratios from the seventh definition. HILL merely uses the fifth for this purpose. (2) It seems probable to HILL that the two assumptions: if $A \gtreqless B$, then $(A : C) \gtreqless (B : C)$ were fundamental with EUCLID in the sense that he first deduced the fifth and seventh definitions from them and only afterwards reversed the process. The appearance of the above definitions at the beginning of EUCLID's argument and without explanation presents grave difficulties to the student, which are avoided in this work. This work is a modification of EUCLID's method, which requires for its understanding a knowledge of elementary algebra. The first three chapters are devoted to an indication of what « magnitudes of the same kind » are (in essentials after STOLZ), some propositions on their integral multiples, and the definition of the « ratio » of two such multiples as a rational number. The (Chap. IV-V-XI) concept of ratio and number are extended so that irrational numbers are introduced, and Chap. VI-IX contain the theory of ratio of commensurable and incommensurable magnitudes based on the above indications; the test for equal ratios is that no rational number lies between them. Applications of STOLZ's theorem simplifying this test are given in Chap. X; and Chap. XII is a commentary on EUCLID's fifth Book.

J.

Smith, Major General, Sir F. — *The Early History of Veterinary Literature and its British Development*. Vol. 1, large in-8º, iv+373 p., 27 figures. London, BAILLIERE TINDALL and Cº, 1919. [25/—]

This is the first attempt in English at a work on the History of veterinary medicine and one of the fullest in any language. It is a

work of much industry and research and its author is certainly to be congratulated on the successful conclusion of what must have involved years of labour.

The work is divided into two parts ; Part I is the shorter of the two. It deals with classical and mediaeval veterinary literature in general. The author has hardly the equipment for this difficult and specialized field, and would, we think, have more wisely postponed its treatment. Nevertheless, his collection has much that is of value that cannot be easily found elsewhere and we are duly grateful for it. Part II is the longer and more important section. It deals with veterinary matters in the XVI^th^ and XVII^th^ centuries and contains a full account of the British literature. It is fully documented and well illustrated, and is likely to form the final authority on the History of Veterinary matters in England for the period in question.

It is a very encouraging sign for the future of Comparative Medicine, — a department of knowledge that has been treated as the Cinderella of the Sciences in British Isles, — that it should have produced so thorough a work of scholarship. We are, however, astonished to learn that this important work should have been issued in an edition of only fifty copies. This is an indication of the very limited circle in England to whom Comparative Medicine makes an appeal. We hope and believe that this minute edition will be rapidly exhausted and that its learned and industrious author will thus have an opportunity of revising some of the material in Part I of this volume in a second édition. In the meantime we look forward with interest to the appearance of the second volume.

CHARLES SINGER.

James J. Walsh. — *Mediaeval Medicine*, in-8°, XII + 221 p. London, A. and C. BLACK, Ltd, 1920. [7/6]

There are certain subjects in which the number of adepts is so very limited that it becomes the duty of the investigator to act also the part of the *vulgarisateur*. The reading public is necessarily more incapable of verifying the statements of such writers than of those who deal with more widely cultivated topics, so that a special charge of accuracy is laid on the interpreter.

Now every reader expects in his author a certain degree of enthusiasm for his subject which may lead him to some overestimate of its relative importance. Moreover, every reasonable reviewer would pardon — with the augur's wink — so consistent a supporter of the Roman Church as Dr. WALSH for some overemphasis of the rôle of the Church in the development of scientific medicine, for it is natural and perhaps not unhealthy for the course of learning that such a

writer should devote himself to the later Middle Ages and seek in the science of that time for entertaining parallels to recent developments.

But when a man of learning and literary facility sets himself seriously to demonstrate, — chiefly by the use of isolated and disputed passages printed at secondhand and without their context, — that mediaeval science reached a level unattained till quite modern times and that the surgery, for instance, of the thirteenth century was superior to that of the eighteenth and even of the early nineteenth century, and when a popular and very widely read author sets out these statements in a work intended for the general reader, then the time has come for the reviewer who has first-hand knowledge of these subjects to enter a protest.

When Dr. WALSH writes that « the surgery of the old Crusades was as interesting and almost as valuable for civil surgery as that of our own Great War », that « HUGH (of Lucca) seems to have been deeply intent on chemical experiments and especially on anodyne and anaesthetic drugs .. In the Middle Ages... many surgeons seem to have experimented with substances that might produce anaesthesia », that JOHN OF ARDERN « made careful statistics of his cases » that « for HILDEGARDE the brain was the regulator of all the vital qualities, the centre of life. She connects the nerves in their passages from the brain and the spinal cord through the body with manifestations of life », that « the Benedictines largely influenced the foundation at Salerno and were important factors in its growth and management », he must know well that however such statements may appeal to the uninitiated public they cannot pass muster among medical historians as fair presentments of the state of medicine in the Middle Ages. He must know, too, that he is using technical terms such as *chemical*, *nerve*, *statistics*, *anaesthesia*, and so on in a way in which such words are not usually understood.

These are not isolated statements but fairly represent the substance and the spirit of the book, and for this reason, despite many attractive elements, it cannot be regarded as giving an account that has any value of an interesting and curious aspect of mediaeval culture. Dr. WALSH's manifest bias has thus deprived him of an opportunity of which his abilities, industry and real learning entitled us to hope that he would avail himself. CHARLES SINGER.

Discovery. — A monthly popular Journal of Knowledge. Edited by A. S. RUSSELL. Published by JOHN MURRAY, London, 1920.

A new undertaking whose chief object is « to give readers an interest both in the Sciences and the Humanities by making the work of the specialists in both as plain as possible ». The aims of Discovery

are thus essentially the same as those of Isis, although the methods are very different. The history of this new journal is very interesting. To quote from the first editorial (Jan. 1920) :

The first conception of the journal was due to the late Prof. JULIUS MACLEOD, of Ghent, a distinguished Belgian botanist, who was a guest of the University of Manchester during the war. His suggestion led to a special conference between a committee of the Council of Humanistic Studies and a committee of the Conjoint Board of Scientific Studies. As a result of this conference, negotiations were commenced, which have since developed until the project has taken its present shape. In October of last year, it was decided that the magazine be maintained under a deed of Trust, the Presidents of the Royal Society and of the British Academy being two of the four trustees. It was decided also that the committee of management be composed of representatives of bodies which have joined in a guarantee of the initial expenses, and also of representatives of learned societies. The former bodies include the National Union of Teachers, the Co-operative Union, the Library Association, the Incorporated Associations of Headmasters and Headmistresses, and the Headmasters' Conference : the latter the Conjoint Board of Scientific Societies, the Classical, Historical, English, Geographical and Modern Language Associations, the British Psychological Society and the Royal Society of Economics. Each of these specialist bodies undertakes to supply, year by year, for our use, a list of contributors who are capable of representing its particular branch of knowledge in articles of a popular kind. We are thus doubly equipped in a way that few new periodicals have been.

No popular journal has ever been launched under such favorable auspices. We will watch the progress of *Discovery* with considerable interest and sympathy. G. S.

George Sarton. — The History of Science. Chicago, *Monist*, vol. XXVI, p. 321-365. Chicago, July 1916.

Explains the meaning of « the history of science », determines its limits, and shows how it should be studied. We must study the development of *all* the sciences together, and this has been hitherto much neglected. A philosophical reaction against too exclusive analysis, of which the author's studies are one aspect, has been principally caused by the great fundamental discoveries in physics chemistry, and biology of the last twenty-five years. The purpose of the history of science, as the author understands it, is to establish the genesis and the development of scientific facts and ideas, taking into account all intellectual exchanges and all influences brought into play by the very progress of civilization. The author examines some of the other departments of life which are the most interesting for the

historian of science : (1) General history or the history of civilization; (2) The history of technology; (3) The history of religions; and (4) The history of fine arts and arts and crafts. The history of science has a great heuristic value; and there is a chance that valuable parts of science may have been passed over in the process of successive selection for text books by which what has been thought to be of value in the growth of science has been preserved. Also, as MACH has pointed out, it is historical knowledge that points out to the scientific man the attitude he ought to take towards the problems with which he has to grapple.

Further, critical work on the scaffolding of science is essentially of a historical nature; for history brings to light all that is accidental and conventional, and prevents science from degenerating into a mass of prejudices. Historical criticism brings order and clearness into science and thus simplifies it. Lastly, the history of science is treated from the pedagogic and humanistic points of view.

Ph. E. B. JOURDAIN.

Bertrand Russell. — Our Knowledge of the External World as a Field for Scientific Method in Philosophy, x+245 p. Chicago and London, The Open Court Publishing Company, 1914.

These eight « LOWELL Lectures » delivered at Boston (Mass.) in March and April 1914, attempt to show, by means of examples, the nature, capacity and limitations of the logico-analytical method in philosophy, which, in the author's opinion, yields whatever scientific knowledge it is possible to obtain in philosophy. « The central problem », says the author, « by which I have sought to illustrate this method is the problem of the relation between the crude data of sense and the space, time, and matter of mathematical physics ». Many of the difficulties between the views advocated here and those of *The Problems of Philosophy* are due to A. N. WHITEHEAD; and much of these lectures is a rough and preliminary statement of what WHITEHEAD will say in the fourth volume of WHITEHEAD and RUSSELLS, *Principia Mathematica*. The author's chief debts are to G. FREGE, on logic, and G. CANTOR, on the mathematical infinite.

Lecture I, on « Current Tendencies », distinguishes three types in present-day philosophies : (1) The classical tradition; (2) Evolutionism, now represented by NIETZSCHE, WILLIAM JAMES and HENRI BERGSON; (3) The author's « logical atomism », which is allied to « the New Realism » and has a logical and mathematical origin. The first two types are criticized; the former partly in connexion with F. H. BRADLEY'S *Appearance and Reality*; the latter chiefly in connexion with BERGSON'S philosophy.

Lecture II, is on « Logic as the Essence of Philosophy; » and shortly describes Aristotelian and mediaeval logic, the method of induction, HEGEL's « logic », and the mathematical logic of LEIBNIZ, BOOLE, FREGE and PEANO. It explains the notion of the « form » of a proposition and shows that this form alone is essential in all inference. It also shows, by the help of the classification used in the logic of relations, that not all relations can be reduced to the predications of traditional logic, and concludes with a discussion of logic, empirical facts, and the intermediate region.

Lecture III, is « On our Knowledge of the External World », and applies the logical-analytic method to the problem referred to. Sense-data are the sole basis of our knowledge of the external world.

Lecture IV, considers the discrepancy between « The World of Physics and the World of Sense », and finds it to be more apparent than real. RUSSELL shows that whatever there is reason to believe in physics can probably be interpreted in terms of sense. At this point is given an illustrative example, due to WHITEHEAD, of how a definition of a mathematical point can be given in terms of sense-data. RUSSELL defines series or classes of sense-data which can be called particles, points and instants. If such constructions are possible, then mathematical physics is applicable to the real world in spite of the fact that its particles, points, and instants are not to be found among actually existing entities; and here the works of POINCARÉ (*Science et hypothèse*) and MACH (*Analysis of Sensations*) are mentioned. Finally, RUSSELL's « principle of abstraction » is discussed.

Lecture V, is on « The problem of Infinity considered Historically ». The explanation of the physical world which assumes infinity and continuity is easier and more natural than any other, and, since the supposed difficulties of continuity all reduce to difficulties concerning infinity in freeing the infinite from contradiction (as, in essentials, GEORG CANTOR has done), we are at the same time showing the logical possibility of continuity as assumed in science. After discussing very thoroughly and rejecting KANT's first two antinomies, which are examples of the way in which infinity has been used to discredit the world of sense, RUSSELL states and explains the problem of infinity, shows how it arose with the Pythagorean discovery of incommensurables, and shows the irrelevance of all the solutions proposed by philosophers from ZENO to BERGSON. Here a valuable contribution is made to the elucidation of the arguments of ZENO and their relation to the doctrines of the Pythagoreans. Still more strongly than PAUL TANNERY, RUSSELL says that ZENO's arguments « are not. », on any view, mere foolish quibbles : they are serious arguments, raising difficulties which it has taken two thousand years to answer, and

which even now are fatal to the teachings of most philosophers... ZENO's arguments, in some form, have afforded grounds for almost all the theories of space and time and infinity which have been constructed from his day to our own. We have seen that all his arguments are valid (with certain reasonable hypotheses) on the assumption that finite spaces and times consist of a finite number of points and instants, and that the third and fourth almost certainly in fact proceeded on this assumption, while the first and second, which were perhaps intended to refute the opposite assumption, were in that case fallacious. We may therefore escape from his paradoxes either by maintaining that, though space and time do consist of points and instants, the number of them in any finite interval is infinite; or by denying that space and time consist of points and instants at all; or lastly, by denying the reality of space and time altogether. It would seem that ZENO himself, as a supporter of PARMENIDES, drew the last of these three possible deductions, at any rate in regard to time... But... the difficulties can also be met if infinite numbers are admissible ». Indeed, if we are to solve all the difficulties derivable from ZENO's by analogy, we must discover some tenable theory of infinite numbers, and the difficulties which philosophers have found in the notion of infinity are then discussed; such as that « there cannot be anything beyond the whole of an unending series. »

Lecture VII, on « The Positive Theory of Infinity », gives a lucid account of GEORG CANTOR's theory of infinity and GOTTLOB FREGE's and RUSSELL's own work on the definition of number, etc. New and very important considerations (partly due to LUDWIG WITTGENSTEIN) on the formal nature of the « logical constants » is indicated.

In Lecture VIII., « On the Notion of Cause, with Applications to the Free-Will Problem », there is first a discussion of causality, in which RUSSELL inquires. (1) What is meant by a causal law; (2) What is the evidence that causal laws have held hitherto; (3) What is the evidence that they will continue to hold in the future; (4) How the causality which is used in science differs from that of common sense and traditional philosophy; (5) What new light is thrown on the question of free will by this analysis of the notion of cause » Finally RUSSELL tries to reach a general account of the logical-analytic method of scientific philosophy, and a tentative estimate of the hopes of philosophical progress which it allows us to entertain.

These lectures are written with that clearness, force, and subtle humour that readers of RUSSELL's other works have learned to expect. But it is also because these lectures contain the first published indication of the new investigations to which the logical and analytical school, of which RUSSELL is the most prominent exponent, is now

tending, that they must be read and studied by all who are interested in science or philosophy, or scientific philosophy.

PH. E. B. JOURDAIN.

W. M. Flinders Petrie. — Tools and Weapons illustrated by the Egyptian collection in University College, London, and 2,000 outlines from other sources. Gr. in 4°, VII+73 p., 4+LXXIX pl. London, British School of Archaeology in Egypt, University College, 1917.

Ever since I had read PETRIE's History of Tools in *Science Progress*, t. 12, p. 71-82, London, 1917, I looked forward to seeing the book of which he then announced the publication, but circumstances delayed the realization of my wish until now. This collection of admirably classified photographs and drawings with introductory explanations is a fundamental contribution to our knowledge of primitive technology, and it throws also much light on the development of early civilization. The book is at the same time a critical catalogue of the Eyptian tools and weapons kept at University College. The sources and dating of each form have been the main object in view. It must be remarked that PETRIE has dealt only with *metal* implements; stone implements, so abundant in Egypt, are not touched on. One of the author's objects being to illustrate the international relations of Egypt, most of his attention has been given to Mediterranean forms. This publication is the more welcome that hitherto while weapons were assiduously studied, tools have been very much neglected. In the classification of the objects of each class, the genetic connection of changes has been followed. PETRIE has also been guided by the legitimate assumption that copper, bronze, iron and brass tools always succeeded in that order, except when there was some individual evidence of dating to the contrary. « No attempt has been made to follow the movements of types as indicating the movements of races. There is not yet enough known, to come to any safe conclusions from such arguments. Sometimes the distribution of a type may be referred to historically known movements of peoples at the same period, which is a legitimate use of history, but a present in our great ignorance of distribution of types, of the dating of objects, of the extent and direction of trade, it is premature to deduce history from types of tools. All that can be said is that strong negative evidence may be drawn from proved dissimilarities, which contradict supposed lines of connection ».

I have quoted this paragraph in extenso to show how cautions the author is We feel safe in his company. Yet his investigations have led him to state certain conclusions which will be startling to many people. I quote them briefly :

I. — « Eighteen different tools, or forms of tools, which were usual in Egypt, were all of them unknown in other lands. Even if there were resemblances to one or two of them, that still leaves the great mass of the usual tools of Egypt standing apart from those of all other countries. This is the case from the Prehistoric age down to the Roman occupation. From the later instances we know that this isolation of types accompanied a considerable intercourse, and does not imply that one country was ignorant of another. What is does mean is that each country had its own independent civilization, had developed its own modes of work, and had thus a barrier against influences of a rival land. »

II. — « Fourteen forms current in other lands, west and east, were ignored in Egypt. »

III. — About as many forms were widely spread in Egypt and abroad. « Thus many lines of trade and connection are indicated by the transfer of the forms of tools, in accord with was is known from other sources, while the remarkable resisting power of each country against the introduction of some of the commonest types, shows how strong and independant were the separate civilizations. »

These conclusions based upon the study of a very large archaeological material which is placed entirely under the eyes of the reader will give much food for thought to the ethnologist and may possibly sober some of them who are too easily taken off their feet by their own imprudent generalizations. For examples and an enumeration of the many tools investigated I must refer the reader to the book itself. Four synoptic tables at the end of the introduction will enable him to see at a glance the distribution in space and time of each form of tool. G. S.

Eighth Critical Bibliography

of the History, Philosophy and Organization of Science and of the History of Civilization

(to April 1920)

This eighth bibliography has been prepared at the Carnegie Institution of Washington and I have to thank the President of the Carnegie Institution, the Secretary of the Smithsonian Institution and the Librarian of Congress for the many courtesies extended to me during its elaboration.

This bibliography contains a large number of German publications, which appeared during the war and which it had not been possible to include in the previous bibliography. There are still many important German publications which I have been hitherto unable to see.

Many of the notes are due to Dr Charles Singer who has become co-editor of *Isis*, and to our much lamented friend Philip E. B. Jourdain. A biography of the latter will appear in a subsequent number of *Isis*. Singer's notes are signed C. S., and Jourdain's, J.

More collaborators are needed to help us fulfill our task. The editor's work would be greatly simplified if the collaborators would kindly : 1. observe the typographical disposition of the published notes and follow it closely; 2. typewrite their notes, using a sheet or slip of paper for each of them and writing on one side only, with little or no underlining and enough space between the lines to allow for corrections; 3. state periodically which periodicals they have read.

Readers and authors alike are earnestly begged to read my article « Synthetic Bibliography » published in the present issue of *Isis*, in which the aim and method of our cooperative undertaking are explained. This will enable the authors to do better their own share of the work and the readers to make a fuller use of it. This article contains also a complete plan of the bibliography. It is well to repeat here once more that Part I is the fundamental classification (by centuries). Part II and III — historical and systematic — contain only such items which could not be included in Part I because they deal with periods longer than *two* centuries.

Medical and biological books and papers should be sent to Dr Charles Singer, Westbury Lodge, Norham Road, Oxford, England; all others to me, Harvard University, Cambridge, Mass., U. S. A.

Carnegie Institution,
Washington D. C. April 26, 1920. George Sarton.

PART I

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Fundamental Classification (centurial)

S. VIII A. C.

Evelyn-White, H. G. Hesiod, the Homeric Hymns and Homerica with an English translation. London, 1914. The Loeb classical library. 1818

This is we believe, the only accessible edition in which the entire works of Hesiod, genuine and apocryphal, are to be found in a single volume Both Hesiod and the Homeric Hymns throw many sidelights on early scientific conceptions. C. S.

S. V A. C.

Bignone, Ettore. (I poeti filosofi della Grecia). Empedocle. Studio critico, traduzione e commenti delle testimonianze e dei frammenti. xii + 688 p. Torino, Bocca, 1916. 1818

Meissner, Bruno. Ein babylonischer Fischereivertrag. *Orientalische Literaturzeitung*, XVII, Sp. 481-483, 1914. 1819

A contract of the time of Darius II, Persian king from 425 to 405.

Taylor, A. E. Parmenides, Zeno and Socrates. *Proceedings Aristotelian Society*, vol. 16, p. 234-289, 1916. 1818

Important contribution to the history of early Greek logical theory. Taylor deals especially with the use made by Parmenides of the appeal to an infinite regress and with his attempted refutation of idealism. As a preliminary to this, he goes into details about the dramatic setting which Plato provided for the discussion, a subject on which the commentators seem to have been unduly silent. J.

Wright, Jonathan. Modern commentaries on Hippocrates. *Annals of Medical History*, II, p. 34-43, 126-135. New York, 1919; *Scientific Monthly*, vol. 9, p. 62-72. New York, 1919. 1818

S. IV A. C.

Boutroux, Léon Sur l'harmonique aristoxénienne. *Revue Générale des Sciences*, t. 30, p. 265-274. Paris, 1919. 1819

Comparaison des théories musicales des Pythagoriciens et des Aristoxéniens basée surtout sur *Cl. Ptolemaei Harmonicorum libri tres.* « Le

système propre d'ARISTOXÈNE repose surtout sur la confusion considérée comme un fait expérimental entre le limma et la moitié d'un ton, confusion géniale qui le conduit à trouver le principe du calcul par logarithmes. Par cette nouvelle manière de calculer les intervalles au moyen d'une unité additive, A. affranchit non pas absolument mais dans la mesure légitime, la musique-art de la musique-science, et il consacre un système d'approximation sans lequel tout le développement de l'harmonie moderne aurait été impossible. » G. S.

Brieger, Walter. Zur Entsalzung des Meerwassers bei ARISTOTELES. *Chemiker Zeitung*, Nr. 74, p. 302. Cöthen, 1918. 1818

Robin, L. Études sur la signification et la place de la physique dans la philosophie de PLATON, 96 p. Paris, ALCAN, 1919. 1818

S. III A. C.

Ovio, Giuseppe. L'ottica di EUCLIDE. XX+416 p., 260 inc. Milano, HOEPLI, 1918. 1818

Sudhoff, Karl. Die eiserne Hand des MARCUS SERGIUS aus dem Ende des 3. Jahrhunderts vor Christo. *Mit. zur Gesch. d. Medizin u. Naturw.*, vol. 15, p. 1-5. Leipzig, 1916. 1818

Perhaps the oldest document concerning an artificial hand. It was made to replace one lost in war by MARCUS SERGIUS, Catilina's great grandfather. Cfr. PLINY, *Nat. Hist.*, lib. VII, ed. MAYHOFF (1875), vol. II, p. 26. G. S.

Thrämer, Ed. CATO CENSORIUS und die Griechenmedizin. *Mitt. zur Gesch. d. Med. u. Naturw.*, XIV, p. 404-405. Leipzig 1915. 1818

S. II A.C.

Leffingwell, Georgia Williams [1893-]. Social and private life at Rome in the time of PLAUTUS and TERENCE. (Thesis, Ph. D.) (Studies in History, Economics and Public Law.) 140 p. New York, Columbia University, 1918. 1818

Regnault, Félix. Terre cuite grecque représentant une femme médecin en consultation. *Bull. de la Société française d'histoire de la médecine*, XIII, p. 47. Paris, 1914. 1818

A terra cotta (British Museum, n° 529) is thought to represent a woman with a lancet in her hand about to perform a minor operation on a second female figure. C. S.

S. I A.C.

Strabo. The Geography of STRABO in eight volumes edited and translated by the late H. L. JONES and J. R. S. STERRETT. Vol. I. First two books. XLIV+532 p. LOEB classical library, London, HEINEMANN, 1917. 1818

First attempt to render into English the most important work on the science of geography that antiquity has left us. The first two books here translated contain the introductory matter on the principles of geography and are for most readers the most interesting of the 17 books of which the entire work is composed. The translation is accompanied by an introduction with very full bibliography. C. S.

S. I

Celsus, Aurelius Cornelius. Opera quae supersunt ed. Fr. Marx. (Corpus Medicorum Latinorum, I) Large in-8°. cxiv + 484 p. Leipzig, 1915. Teubner. 1818

This very fine work of scholarship has brought the text of Celsus to its final stage. Editions of texts though highly necessary and laborious to prepare are not easy to praise. In this instance we are provided with everything that such a work should give. With this volume and the concordance of Milligan the student of Celsus is now provided with a complete apparatus. It is much to be regretted that there is no satisfactory translation into English of this very valuable and interesting medical work. C. S.

Feis. Verwendung des Menstrualblutes bei Josephus. *Mitt. zur Gesch. d. Med. u. Naturw*., t. 18, p. 256-257. Leipzig, 1919. 1818

Two footnotes to Josephus Flavius (Joseph ben Matthias; 37-ca 95), *de bello judaico*, IV, c. 8, 4; VIII, c. 6, 3. G. S.

Smith, Vincent A. The Indian travels of Apollonius of Tyana. *Zeitschrift der deutschen Morgenländischen Ges.*, t. 68, p. 329-344, 1914. 1818

Apol. was in all probability not more than 80 at the time of his death in 97 or 98. We may accept his journey to Babylonia and India as a fact; is took place within the years 39-47. The Indian journey is best assigned to the cold season of 43-44. The statements of Apol. concerning the diffusion in the Panjâb of the knowledge of Greek language, literature and mythology are grossly exaggerated. G. S.

Wellmann, Max. Die Aufidius-Hypothese des neusten Celsus-Herausgebers. *Mitt. zur Gesch. d. Med. u. Naturw*., t. 16, p. 269-290. Leipzig, 1917. 1818

Sharp and thorough criticism of Friedrich Marx' edition, 1915. Wellmann is absolutely opposed to this editor's theory that Celsus' work is based upon a work of T. Aufidius Siculus, a pupil of Asclepiades (120-40 B. C.). Aufidius' work is only known through extracts quoted by Caelius Aurelianus and the discussion is centered upon a comparison between these extracts and the corresponding texts in Celsus. G. S.

S. II

Galen. In Hippocratis de natura hominis; in Hippocratis de victu acutorum; de diaeta Hippocratis in morbis acutis, ed. I. Mewaldt, G. Helmreich et I. Westenberger (Corpus Medicorum Graecorum, V, 9, 1), xlviii + 488 p. Leipzig, Teubner, 1914. 1818

Galen. In Hippocratis Prorrheticum I; de comatae secundum Hippocratem; in Hippocratis prognosticum, ed. H. Diels, I. Mewaldt et I. Heeg (Corpus medic. graec., V, 9, 2), xxxiv + 492 p. Leipzig, Teubner, 1915. 1818

The publication of the Corpus medic. graec. under the auspices of the Universities of Berlin, Copenhagen and Leipzig has naturally proceeded but slowly during the last six years. These accurate, scholarly and beautifully printed texts replace as they appear the wretched edition of Kühn. The establishment of these texts, together with those of the *Corpus medic. latin.* is perhaps the most noteworthy event in the historical study of medicine in our time. C. S.

Galen. On the Natural Faculties, edited and translated by A. J. Brock Loeb Classical Library, London, Heinemann, 1916. 1818

It is a remarkable fact that the works of one of the greatest physicians of all time have never been rendered into any modern language. English is perhaps the worst off of all for except a small privately printed fascicule (On the Hand by Thomas Bellot, 1848), until now there was no work of G. translated into it. Dr Brock is thus a pioneer and his work will be accordingly prized. The work he has chosen is thoroughly illustrative of G's method and his translation, fluent and accurate. The introduction however is not satisfactory for while any information concerning G. would be valued, it is yet impossible to tell the history of ancient, mediaeval and Renaissance medicine in the course of 30 small pages. C. S.

Gossen, Iohannes. [1884-] De Galeni libro qui σύνοψις περὶ σφυγμῶν inscribitur. Diss. inaug. phil., 39 p. Berlin, 1917. 1818

Pausanias. Description of Greece edited with an English translation by W. H. S. Jones, in six volumes. Loeb classical library, London, Heinemann Vol. I, 1918. 1818

We welcome this edition as more handy and accessible than the monumental ed. of Sir J. G. Frazer. The character of Pausanias' work requires copious annotation and the design of the series might have been somewhat modified to allow for this. There is an admirable but too brief introduction. C. S.

Sehütte, Gudmund. Der Ursprung der handschriftlichen Ptolemäus-Karten. *Mitt. zur Gesch. d. Med. u. Naturwiss.*, t. 13, p. 573-577. Leipzig, 1914. 1818

A survey of cartographical technique enables one to date the first manuscript Ptolemaic maps. The existence of picturesque peculiarities, chiefly representations of men and animals, furnishes the necessary criterium. One thus obtains the following series: I. Ptolemaic maps (text, IIIrd cent.); European local maps of the *Notitia Dignitatum* (IVth c.); II. *Tabula Peutingeriana* (IVth); III. Asiatic and African local maps of the *Notitia Dignitatum* (Vth); mosaic map of Madaba in Palestine (VIth). G. S.

Sudhoff, Karl. Vom Pestsamen des Galenos. *Mitt. zur Gesch. d. Med. u. Naturwiss.*, t. 14, p. 227-229. Leipzig, 1915. 1818

About the τινὰ λοιμοῦ σπέρματα to which Galen refers in his περὶ διαφορᾶς πυρετῶν (I, 6), also in his πρὸς Πίσωνα περὶ τῆς θηριακῆς (16). These two texts are insufficient to prove that Galen had any clear idea of a theory of infection. G. S.

S. III

Lippmann, Edmund O. von. Ueber chemische Papyri des 3. Jahrhunderts n. Chr. *Chemiker Zeitung*, p. 589. Coethen, 1917. Reprint. 5 p. 1818

The author's new essay on the Leidener and Stockholmer papyri which he first studied in 1913, is suggested by Mrs. Ingeborg Hammer Jensen's investigations (Danish Acad. of Sciences, 1916). G. S.

Serenus, Quintus. Liber medicinalis ed. F. Vollmer. (Corpus medic. latin., II, 3.) Large in-8°, 26 + 80 p. Leipzig, Teubner, 1916. 1818

A medical poem probably of the IIIrd cent., which exercised considerable

influence on the very few medical works that have come down to us of the Dark Ages (e. g. BENEDICTUS CRISPUS and WALAFRID STRABO). The work attained some popularity in the XVI^th century. There has been no critical edition till now. See VOLLMER, Nachträge..., Philologus, t. 75, p. 128-133.
C. S.

S. IV

Ausonius, Decimus Magnus. Edited and translated by H. G. EVELYN-WHITE, in 2 vol. LOEB classical library. London, HEINEMANN, vol. I, 1919. 1818

Lippmann, Edmund O. von. Ueber das erste Vorkommen des Namens « Chemie ». *Chemiker Zeitung*, p. 685. Coethen, 1914. 1818

The first use of the word chemia has been generally ascribed to JULIUS FIRMICUS MATERNUS, in his astrological textbook Mathesis, A. D. 337. But the relevant phrase : *scientiam alkamie* (*alchimiae*) is an obvious interpolation introduced by JOH. ANGELUS in the partial ed. of the Mathesis included in his Opus Astrolabii, Augsburg 1488 and which was kept in the ed. princeps, Venice 1497 and later ed. The first use of the word Χημία or χημεία is found in the writings of the Alexandrine writer ZOSIMOS of Panopolis (III^rd cent.). G. S.

Sudhoff, Karl. Theodosianische Kriegsinvalidenversorgnung. *Mit. zur Gesch. d. Med. u. Naturw.*, t. 16, p. 431-433. Leipzig, 1917. 1818

This particular law (VII, de veteranis titulus XX) dates of A. D. 320. SUDHOFF publishes with it JACOBUS GOTHOFREDUS' commentary (Mantuae, 1740). G. S.

S. V

Marcellus Empiricus. De medicamentis, ed. M. NIEDERMANN. (Corpus medicorum latinorum, V), large in-8°, XXVI + 368 p. Leipzig, TEUBNER, 1916. 1818

The Institute for the History of Medicine at Leipzig among its many other services to scholarship is promoting a complete corpus of the Latin medical writers. M. E. of Bordeaux represents the lowest type of provincial superstition. His work is interesting not simply to the philologist and to the medical historian but also to the anthropologist. It is also important for the influence it had on the early English medical literature. Good critical edition. The index though copious, we have found less useful than we had hoped. C. S.

S. VI

Probst, O. ISIDORS Schrift de medicina. *Archiv für Gesch. d. Med.*, VIII, p. 22. Leipzig, 1914. 1818

Scanty as is the glimpse of medical practice afforded by ISIDORE, there is no other source of the VI-VII^th cent. that is more valuable. The author endeavours to trace I.'s medical ideas to the sources. He makes out a good case for the relationship of the Isidorian text to CAELIUS AURELIANUS and to the Pseudo Soranic Quaestiones medicinales. C. S.

Procopius. History of the Wars, edited and transl. by H. B. DEWING (in 7 vol.). Vol. I-III, LOEB Classical Library. London, HEINEMANN, 1914-1919. 1818

Sudhoff, Karl. Die Verse Isidors von Sevilla auf dem Schrank der medizinischen Werke seiner Bibliothek. *Mit zur Gesch. d. Med u. Naturw.*, XV, p. 200-204. Leipzig, 1916. 1818

S. VII

Laufer, Berthold. Origin of Tibetan writing. *Journal of the American Oriental Society*, t. 38, p. 34-46, 1918. 1818

Criticism of the fanciful theory of A. H. Francke, later indorsed by A. F. R. Hoernlé, according to which writing would have been introduced into Tibet from Turkistan, more particularly from Khotan. L. shows that the Chinese and Tibetan annals agree in establishing that it was introduced into Tibet from India during the reign of King Sroń-btsan sgam-po between 630 and 648 A. D. by T'on-mi or T'ou-mi. G. S.

S. VIII

Cook, Albert Stanburrough [1853-]. The old English Elene, Phœnix and Physiologus, lxxxix + 241 p. New Haven, Yale University, 1919. 1818

Edition of these three little writings, ascribed to Cynewulf, with critical introductions, notes, bibliographies and glossaries. G. S.

Degering, Hermann. Ein Alkoholrezept aus dem 8. Jahrhundert, *Sitzungsber. d. kgl. Preuss. Ak. d. Wiss.*, t. 36, p. 503-515. Berlin, 1917. 1818

For criticisms of this work see Lippmann and Sudhoff under S. xii. G. S.

Vallauri, Mario. Un testo medioevale indiano di medicina. *Riv. di storia critica d. sc. med. e natur.*, t 7, p. 6-10, 1916. 1818

Treatise of pathology by Vrinda-Madhava of which the author is preparing a translation. It is the first Indian text in which pathology is treated as a separate branch of science. Vrinda wrote also a treatise of therapeutics entitled Siddhayoga (perfect cure). Vallauri gives the table of contents of the first treatise. G. S.

S. IX

Sudhoff, Karl. Das Kapitel über die Krankenpflege in der Benediktinerregel mit althochdeutschen Interlinearglossen in einer St. Galler Handschrift des 9. Jahrhunderts. *Mit. zur Gesch. d. Med. u. Naturw.*, t. 14, p. 4-5; t. 16, p. 114. Leipzig, 1915-1917. 1818

S. XI

Feldhaus, F. M. Medizinisches aus dem Theophilus, um 1100. *Mit. zur Gesch. d. Med. u. Naturw.*, XVI, p. 436-437. Leipzig, 1917. 1818

Ex Theophilus' *Lumen animae*.

Feldhaus, F. M. Ueber die Kennzeichen an Glocken der ältesten Periode. *Geschichtsblätter für Technik...*, t. 3, p. 100-104, 1916. 1818

The oldest European text relating to bell founding is by Theophilus, ca. 1100 (publ. in 1874 by R. Eitelberger von Edelberg in *Quellenschr. f. Kunstgesch.*, t. VII). F. maintains that Theophilus describes the

Chinese technique, which was abandoned in Europe ab. 1200. The oldest clock of this kind (at least in Germany) hung in Diesdorf, is now in the Museum of Halle; it must date of ca. 1011. The oldest dated clock, 1144, is in Iggensbach. It is here reproduced. F. describes the characteristics of these oldest bells. G. S.

Sudhoff, Karl. Ein krankenbericht des THEOPHYLAKT (11. Jahrh., Bulgarien). *Mit. zur Gesch. d. Med. u. Naturw.*, t. 15, p. 473. Leipzig, 1916. 1818

Apropos of a short text in MIGNE. Patrol. graeca, posterior, t. 126, col. 477; 1864.

Victoria and Albert Museum. Department of Textiles. Guide to the Bayeux Tapestry, 42 p., XII plates. London, 1914. 1818

Contains a description of this famous « embroidery » (for it is no properly speaking a tapestry), also its history, the Latin inscriptions with translations, notes on the photography kept at the Museum, bibliogr. and index. G. S.

S. XII

Lippmann, Edmund O. von. Neue Beiträge zur Geschichte des Alkohols. *Chemiker Zeitung*, p. 865, 883, 909. Reprint, 15 p. Coethen, 1917. 1818

Discussion of DEGERING's article (see under S. VIII). This alcohol recipe was found in a XII-XIIIth cent. Ms. in the Premonstrants Convent of Weissenau. It is essentially the same as another XIIth cent. recipe of a San Gimignano Ms. publ. by PUCCINOTTI in his Storia della Medicina (1855). DEGERING traces these two Mss. back to a common VIIIth cent. source. SUDHOFF (see below) and LIPPMANN reject this conclusion. According to the latter, the Ms. W (that is the Weissenau Ms.) may be dated back as well as the one of the *Mappae Clavicula*, to the XIth cent.; the Ms. G (that is the San Gimignano Ms.) is a later one. There is no proof that other texts have preceded W; for all that we know W may well be the earliest or one of the very earliest texts of its kind. If earlier texts exist they cannot be much older. An VIIIth cent. source is entirely out of the question. G. S.

Singer Charles A review of the medical literature of the Dark Ages with a new text of 1110. *Section of Hist. of Med., Proc. Royal Society of Med.*, t. 10, p. 107. London, 1917. 1818

Gives a long text that was in use in an Anglo Saxon monastery, traces the relation of the medical system of Anglo Saxon England to some of its sources, especially Salerno. Brief account of the state of medecine in the Dark Ages. C. S.

Sudhoff, Karl. Eine neue Handschrift des « Liber medicinalis » Pseudo-Democriti aus dem 12. Jahrh. *Mit. zur Gesch. d. Med. u. Naturw.*, t. 14, p. 315-322. Leipzig, 1915. 1818

Codex B. 61 (p. 145 v — 153 r) of the Biblioteca Vallicellana, Rome. This codex contains a « Dyascorides », an alphabetical « Liber graduum », a short « Liber de quatuor humoribus » and finally the « Liber medicinalis Democriti philosophi » which S. describes and compares with a similar Ms. analyzed by Jos. HERG in 1913, namely the Augiensis lat CXX, written about 900, and also with two other Mss. still unpublished, the Monacensis lat. 1487 and the Monacensis lat. 23535. Fragments of Vallic. B. 61 are quoted. G. S.

Sudhoff, Karl. Der Pistoiese Accorso (Accursius) und die Uebersetzung des pseudo-galenischen « Liber regiminis vel de virtutibus cibariorum », auch « de dissolutione continua » genannt. *Mit. zur Gesch. d. Med. u. Naturw.*, t. 16, p. 24-27. Leipzig, 1917. 1818

Sudhoff, Karl. Ein Alkoholrezept aus dem 8. Jahrhundert? Naturwissenschaftliche Wochenschrift, XVI, p. 681-683. Jena, 1917. 1819

Criticism of an article of Degering (see under S. VIII; see also Lippmann under S. XII) which would confirm Diels' theory according to which the making of alcohol can be traced back to ancient times through the Mappae Clavicula etc.. S. shows the fragility of Degering's argument. According to S. this alcohol recipe dates of the early XIII^th^ cent. G. S.

Sudhoff, Karl. Zur Anatomie des Vindicianus. *Archiv f. Gesch. d. Medizin*, VIII, p. 414-423. Leipzig, 1915. 1818

Gives the text from a XII^th^ and a XIV^th^ cent. Ms. of a short anatomy sometimes described in the Middle Ages as an « Anatomia Galeni » sometimes as « Epistola Vindiciani ». C. S.

Sudhoff, Karl. Die Kurze « Vita » und das Verzeichnis der Arbeiten Gerhards von Cremona. *Arch. f. Gesch. d. Med.*, t. 8, p. 73-82. Leipzig, 1914. 1818

The name of Gerard of Cremona is attached more frequently than any other to Latin versions of Arabic scientific and philosophic works. An account of him prepared by a pupil was long ago discovered and publ. by Boncompagni. This text is here reprinted by Sudhoff from four Mss. together with the identifications of some of the 71 works with which it credits Gerard as a translator. C. S.

Wiedemann, Ellhard und **Hauser, F.** Ueber Schalen die beim Aderlass verwendet werden und Waschgefässe nach Gazari. *Archiv f. Gesch. d. Med.*, II, p. 22, 1918. 1818

Detailed description with diagrams of a series of pneumatic instruments. The work from which these are taken is by a Mesopotamian writer who fl. at the end of XII and the beg. of XIII; its derives its inspiration from Hero. It is now widespread in the East. The authors have themselves made models in imitation of some of these figures; these figures imply a good Knowlegde of hydrostatics. C. S.

S. XIII

[Bacon, Roger]. *The Open Court*, vol. 28, p. 449 sq Chicago, 1914. 1818

The number of the *Open Court* for August, 1914, is entirely devoted to a celebration of the 700^th^ anniversary of the birth of Roger Bacon (1214-1292), and contains many portraits of him. After a short introductory note to the number, by Carus, an anonymous biography of B. is reprinted from *Old England's Worthies* (London, 1853). Dühring's contrast between Roger Bacon and Francis Bacon, very much in the favour of the former, is translated by Lydia G. Robinson from Dühring's *Kritische Geschichte der Philosophie*. Lloyd shortly discusses B.'s metaphysics, methodology, and moral philosophy; Guthe discusses B.'s knowledge of mathematics, astronomy, and optics, and his attitude towards magic, astrology, and alchemy; and Jourdain points out the correctness of B.'s attitude towards Aristotelian logic, and gives an interesting proof of B.'s that a continuum is not composed of points. J.

Baeumker, Clemens [1853-]. Roger Bacon's Naturphilosophie, insbesondere seine Lehren von Materie und Form, Individuation und Universalität, v + 74 p. Münster i. W., Aschendorff, 1916.

1918

Bindoni, Giuseppe. Indagini critiche sulla Divina Commedia con disegni e tavole illustrative, 664 p. Milano, Albrighi e Segati, 1918.

1918

Ferckel, C. Diagramme der Sexualorgane in mittelalterlichen Handschriften. *Archiv f. Gesch. d. Med.*, X, p. 255, 1 pl., 1917. 1918

Small but valuable collection of texts and figures of the organs of sex. One of these is taken from a IX^th^ cent. Ms. and five from XIII^th^ cent. Mss

C. S.

Handerson, Henry E. [1837-1918]. Gilbertus Anglicus, Medicine of the XIII^th^ century, with a biography [bibliography and portrait] of the author, 77 p. Cleveland Medical Library Association (for private distribution). Cleveland, Ohio, 1918. 1918

There are not many effective studies in English of the work of mediaeval physicians and this is certainly the best and most lucid that has yet appeared. The book is scholarly and thorough without being heavy and does credit both to its author and to the Society that has issued it. C. S.

Hertling, Georg Friedrich Graf **von** [1843-]. Albertus Magnus. Beiträge zu seiner Würdigung. 2^te^ Aufl., VIII + 183 p. (*Beitr. zur Gesch. d. Philos. des Mittelalters*, XIV). Münster i. W., Aschendorff, 1914. 1918

First ed., 1880.

Lippmann, Edmund O. von. Thaddaeus Florentinus (Taddeo Alderotti), über den Weingeist. Durchgesehen v. Karl Sudhoff, *Archiv f. Gesch. d. Med.*, t. 7, p. 379-389. Leipzig, 1914. 1918

Extract from a Ms. work of Taddeo Alderotti (1233-1303), Ms. Vaticanus nr. 2418, 156, his « *Consilia* ». This XIV^th^ cent. Ms. was deciphered by H. Bloch. The extract quoted is the end of the Ms., it begins : « Hec sunt virtutes aque vite primo quod omnes passiones in corpore extremis humoribus procedentes curat sive eicit intrinsece sive extrinsece »... (in all 322 livres). G. S.

Morgenstern, Arthur [1889-]. Das Aderlassgedicht des Johannes von Aquila und seine Stellung in der Aderlasslehre des Mittelalters, samt dem Abdruck der lateinischen Uebersetzung der Schrift Peri flebotomia Ypokratis nach den Handschriften in Bruessel und Dresden. (Med. Inaug. Diss., Leipzig) 80 p. Leipzig, Robert Noske, 1917. 1918

Sandys, Sir J. E. Roger Bacon, *Proceedings of the British Academy*, vol. 6, 18 p. London, 1914. 1918

A very useful bibliographical summary. C. S.

Singer, Charles Thirteenth century miniatures illustrating medical practice. *Section of the Hist. of Med., Proc. R. S. of Med.*, IX, p. 29. London, 1916. 1918

Gives a series of figures from a Bodleian Ms. of about 1290, illustrating various aspects of medical life, among them a post mortem examination.

C. S.

Steele, R. R. A Mediaeval Panacea. *Section of the Hist. of Med., Proc. R. S. of Med.*, X, p. 93. London, 1917. 1818

Describes a common mediaeval panacea with the prescription of Roger Bacon whose text is given. C. S.

Sudhoff, Karl. Graphische Darstellungen innerer Körperorgane. *Archiv f. Gesch. d. Med.*, t. 7, p. 367. Leipzig, 1914. 1818

Describes the separate organs figured in two XIII^th^ cent. Mss. (Oxford and Pisa). The two sets are strikingly alike and illustrate the fixity of mediaeval anatomical tradition. In the later part of the paper, S. presents us with 4 figures illustrating mediaeval post mortem methods. One of these is from a XIII^th^, one from a XIV^th^ and two from XV^th^ cent. Mss. C. S.

Sudhoff, Karl. Die Oxforder anatomische Fünfbilderserie des Cod. Ashmole 399. *Archiv f. Gesch. d. Med.*, t. 7, p. 363, 1914. 1818

Describes what is perhaps the best executed set of the curious five figure series, a group of figures which enshrined a peculiar pre-Arabian anatomical tradition that was in circulation in W. Europe from the XII^th^ to the XV^th^ century. It is probable that these diagrams were of Alexandrian origin. C. S.

Sudhoff, Karl. Elf ansteckende Krankheiten vor 1300. *Mit. zur Gesch. d. Med. u. Naturw.*, t. 16, p. 132-134, 1917. 1818

Ex Leipzig Codex 1119, verso of last parchment leaf written at the end of XIII^th^ cent.

Hii sunt morbi contagiosi, id est inficientes alios
Febris acuta, ptysis, scabies, pedicon, socer ignis
Cancer, lippa, lepra, frenesis, squinancia, antras

Such verses are not unfrequently found in Mss. of the XIII, XIV and XV^th^ cent., but the number of contagious diseases quoted is generally 5, 8 or 9. The text quoted above mentions 11 diseases and moreover is the oldest text of this kind found thus far. See also under S. XIV. G. S.

Sudhoff, Karl. Ein handschriftlicher Splitter zur Pharmakognostik aus dem 13. Jahrhundert. *Mit. zur Gesch. d. Med.*, t. 18, p. 155, 1919. — Abergläubische u. Kosmetischen Vorschriften. *Ibidem*, 255-256. 1818

Two extracts from Cod. 204 quarto, Amplonianus, Erfurt, an Italian parchment Ms. of a little after 1250. G. S.

Sudhoff, Karl. Die Anatomie und die Kirche im Mittelalter. *Mitt. zur Gesch. d. Med.*, t. 14, p. 92, 1915. 1818

Short note with reference to Wickersheimer's paper (*Arch. f. Gesch. d. Med.*, t. 7, p. 12-14). Although the Church did not absolutely prohibit anatom. dissections in XIII^th^ and XIV^th^ cent., it controled them, at the same time protecting the anatomists against popular prejudices. The Bull of Boniface VIII (1300) was misunderstood; nevertheless Guido da Vigevano (preface to his anat., 1345) says quite clearly: « Quia prohibitum est ab Ecclesia, facere anathomiam in corpore humano... ». G. S.

Wickersheimer, Ernest. Les origines de la Faculté de médecine de Paris. *Bull. Soc. franç. hist. de la méd.*, t. 13, p. 249. Paris, 1914. 1818

W. gives reason for dating the *facultas phisica* as far back as 1231. The references to medical study at Paris in XII^th^ c. do not justify the title faculty. C. S.

Würschmidt, Joseph [1886-]. THEODORICUS TEUTONICUS DE VRIBERG, de iride et radialibus impressionibus. DIETRICH VON FREIBERG, über den Regenbogen und die durch Strahlen erzeugten Eindrücke. Zum ersten Male nach den Handschriften hrg. u. mit einer Einleitung. versehen, *Beiträge zur Gesch. d. Phil. d. Mittelalters*, t. 12, XV + 204 p., diagr. Münster i. W., 1914. 1818

S. XIV

Chartularium studii bononensis. Documenti per la storia dell'Università di Bologna dalle origini fino al secolo XV. Pubblicati per opera della commissione per la storia dell'Università di Bologna. Vol. IV. f°, 333 p. Bologna, 1919. 1818

Bologna was the earliest university after Salerno to have a faculty of medicine. The documents in this vol. refer to the XIV^th^ cent.; many are of a medical character. C. S.

Diels, Hermann. Ueber die Schrift Antipocras des NIKOLAUS VON POLEN. *Sitzungsber. der Kgl. Preuss. Akad. d. Wiss.*, p. 376-394. Berlin, 1916. 1818

Criticism of SUDHOFF'S public. in *Arch. f. Gesch. d. Med.* IX, p. 31-52, 1915, to which SUDHOFF answers at great length in *Mit. zur Gesch. d. Med.*, XV, p. 152-155, 1916. SUDHOFF'S answer is very illuminating. However much DIELS may think fit to criticize him, all the historians of science can but admire SUDHOFF'S wonderful activity and his inexhaustible learning. G. S.

Frati, Lodovico. ALBERTO DE' ZANCARI. *Riv. di storia delle scienze*, t. 5, p. 329-338. Roma, 1914. 1818

Bolognese anatomist of the first half of S. XIV. Biographical sketch with list of his writings (all in Ms.); 3 biographical documents are given *in extenso*. G. S.

Morris, Manuel. Die Schrift des ALBERTUS DE ZANCARIIS aus Bologna. *De cautelis medicorum habendis*, nach Leipziger und Pariser Handschriften. (Inaug. Diss., Leipzig), 44 p. Leipzig, F. PETER Nachf., 1914. 1818

Singer, Dorothea Waley. Some plague tractates (XIV^th^ and XV^th^ cent.) *Section of the hist. of med., Proc. R. S. of Med.*, t. 9, p. 159-212. London, 1916. 1818

Describes 22 short tracts advising on comportment in presence of the plague. The tract of JOHN OF BURGUNDY (Sir JOHN MANDEVILLE) of 1365 is printed in full in a French version that is perhaps its original form. The relation of this tract to the author of the « Travels of Sir JOHN MANDEVILLE » is discussed. C. S.

Sudhoff, Karl. Pestschriften aus den ersten 150 Jahren nach der Epidemie des « schwarzen Todes » 1348. N^r^ VII-VIII. *Archiv. f. Gesch. d. Med.*, t. 8, p. 175-215, 236-289. Leipzig, 1914. 1818

Two more of a long series of articles and texts published by S., illustrating the attitude of the mediaeval physician towards visitations of the plague. The series when complete will form a very valuable study of an important aspect of mediaeval life. C. S.

Sudhoff, Karl. Augendurchschnittsbilder aus Abendland und Morgenland. *Archiv. f. Gesch. d. Med*, t. 8, p. 1; 1914. 1818

A group of texts and figures of XIV^th^ and XV^th^ cent. illustrating the contem-

porary views on the structure of the eye. The essential unity of these views is demonstrated. S. then proceeds to link up the Western with the Eastern view. Here again the two groups are in essential unity but these are minor divergences which it is not easy to account for. C. S.

Sudhoff, Karl. Fünf ansteckende Krankheiten. *Mit. zur Gesch. d. Med. u. Naturw.*, t. 14, p. 405-406; 1915. 1918

Ex Ms. Breslau univ., III, fol. 20, f. 102 v., second half of XIV^th^ cent.

Nota quinque sunt morbi contagiosi unde versus :
Lepra, febris, lippa, scabies, morbusque caducus
Corporibus nostris transicione nocent

With notes on other contemporary texts refering to 5 or 8 contagiou diseases. See also under S. XIII. G. S.

[Sudhoff, Karl.] Eines Rostocker Arztes aus der Mitte des 14. Jahrh., Magister Henricus de Rodestock, Gesundheitsregel. *Mit. zur Gesch. d. Med.*, t. 18, p. 32-33; 1919. 1918

« Nota regimen medicum secundum magistrum Henricum de Rodestock. Primo debes vitare cibaria ventosa... » (27 lines), ex Msc. III, A, I, of the University library of Breslau. G. S.

S. XV

Feldhaus, F. M. Drahtzieher im 15. Jahrhundert. *Geschichtsblätter f. Technik*, t. 2, p. 153-155; 1915. 1918

Johnsson, J. W. S Les origines de la syphilis en Danemark. *Bull. Soc. franç hist. méd.*, t. 13, p. 122; 1914. 1918

Two early entries in the Danish records which negative the Columbian origin of syphilis : one in 1483 before the discovery of America, the other in 1493 before the Naples outbreak. C. S.

Library of Congress. Catalogue of the John Boyd Thacher [1847-1909]. Collection of Incunabula, compiled by Fred. W. Ashley, 329 p., illustr. Washington, Government Printing Office, 1915. 1918

Meyerhof, M. Die erste Erwähnung der Syphilis in Aegypten, 1498 n. Chr. *Mit. zur Gesch. d. Med.*, t. 16, p. 438; 1917. 1918

In the chronicle of Ibn Ijas, reference to a « French eruption » (al-habb al-frangi) at the end of 903 A. H (= 1497-1498 A. D.). The first Arabic physician to mention syphilis is Ibn-Sallûm (cfr. Seidel in Sudhoff's Festschrift). G. S.

Ross, Sir E. Denison. Note on a school of Oriental languages in China. *New China Review*, t. 1, p. 38-40. Hongkong, 1919. 1918

The « office of foreigners » (Ssù-i-kuan) established in 1402 by the Ming emperor Yung-lo. G. S.

Sticker, Georg. Morbus gallicus. *Mit. zur Gesch. d. Med. u. Naturw.*, t. 15, p. 77-78; 1919. 1918

Sudhoff has already shown that the Mal de Naples of 1495, which marks the beginning of the legendary history of syphilis, was really an epidemic of abdominal typhus. St. calls the attention upon a very similar epidemic which broke out at the siege of Louvain by the French in 1635, was then carried to Nymegen and there carefully described by Isbrand van Diemerbroeck, who uses the words *febris gallica*, *morbus gallicus*. G. S.

Singer, Charles. Figures of the Bristol GUY DE CHAULIAC MS. (circa 1430). *Section of the hist. of med., Proc. R. S. of. med.*, t. 10, p 71; 1917. 1818

Examines the figures of surgical instruments in a neglected Ms. and seeks to bring them into line with the general course of mediaeval surgery. C. S.

Sudhoff, Karl. Die graphische Weiterbildung der anatomischen Fünfbilderserie aus Alexandrinerzeit und eine anatomische Serie aus Stockholm. *Archiv f. Gesch. d. Med.*, t. 8, p 129-145, 2 pl.; 1914. 1818

Describes a remarkable series of anatomical drawings in the five meter long parchment « Roll of JOHN ARDERN » at Stockholm. The series involves some interesting sections which were perhaps copied or suggested from Mss. of HENRY DE MONDEVILLE. C. S.

Sudhoff, Karl. HEINRICH LOUFFENBERGS « Versehung des Leibs » in Versen (1429). *Mit. zur Gesch. d. Med.*, t. 15, p. 188-191; 1916. 1818

Sudhoff, Karl. Ordnung für das St. Antonius-Spital zu Bern aus dem 15. Jahrhundert. *Mit. zur Gesch. d. Med.*, t. 14, p. 407-409; 1915. 1818

Sudhoff, Karl. Mittelgriechische Beschwörungen und Gebete gegen Krankheiten und eine Liste von Körperteilen aus einem ἐξορκισμός, *Mit. zur Gesch. d. Med.*, t. 16, p. 257; 1917. 1818

Extract from an exorcism dating of XV^th^ or XVI^th^ cent., publ. by A. T. ALMASOF in *Ljetopisj*, VI, Odessa, 1901, containing long enumeration of parts of the body and organs from which the evil πνεύματα ἀκάθαρτα) must be conjured away.

Torkomian, V. H. AMIRDOLRATHE D'AMASSIE, médecin arménien du XV^e^ siècle. *Bull. Soc. franç. hist. méd.*, t. 13, p, 444; 1914. 1818

A welcome addition to the very small list of writings on Armenian medicine, a system mainly derived from Arabian and Syriac sources. C. S.

Wickersheimer, Ernest. Les maladies épidémiques ou contagieuses et la Faculté de médecine de Paris de 1399 à 1511. *Bull. Soc. franç. hist. méd.*, t. 13, p. 21; 1914. 1818

Deals with references to plague, leprosy and syphilis in the *Commentaires* of the Faculty of Med., Paris. C. S.

Winship, George Parker (*editor*). Census of fifteenth century books owned in America. Compiled by a committee of the Bibliographical Society of America, XXIV+245 p. New York, Public Library, 1919. 1818

See *Isis*, III, p. 103. Reprinted with additions Sept. 1919 (p. 226-245) from the *Bull. of the N. Y. Public Library* of April-Decemb. 1918, August 1919. An introduction retraces the history of the undertaking and explains the methods followed. The Census reports over approximately 13.200 copies of more than 6.640 titles, on the basis of information collected from 169 public and 246 private collections. Most useful undertaking very ably carried through. Let us hope that G. P. WINSHIP will be given the necessary facilities to keep this Census up-to-date. His address is : Widener Library, Cambridge, Mass. G. S.

Zaunick, Rudolph. Tintenrezepte des 15. und 16. Jahrhunderts. *Geschichtsbl. f. Technik*, t. 4, p. 74-75. Berlin, 1917. 1818

Zaunick, Rudolph. Klage über die Säuglingssterblichkeit im 15. Jahrhundert. *Mit. zur Gesch. d. Med.*, t. 14, p. 229, 1915. 1818

Zimmermann, L. Saladini de Asculo... Compendium aromatorium, VIII + 142 p. Leipzig, Barth, 1919. 1818

Saladini's work on drugs was written between 1441 and 1463. Latin text and transl. is here given from a printed ed. of 1572. It gives us a good idea of the drug armamentarium of the Renaissance physician. It contains a contemporary list of the works needed, a catechism on the nature and uses of drugs, a description of medical herbs, their habitats and the method and time of gathering them, their doses etc. It is under the strongest Arabian influence and uses many Arabian terms. C. S.

Baldacci, Antonio. Leonardo da Vinci, botanico e fondatore del metodo sperimentale. *Memorie d. R. Accad. d. Sci. dell' Istituto*, serie VII, t. I, 14 p. Bologna, 1914. — La botanica di Leonardo da Vinci desunta dai manoscritti della Biblioteca dell' Istituto di Francia, *Ibidem*, II, 20 p., 1915. — La botanica nel Codice Atlantico, *Ibidem*, III, 26 p., 1916. 1818

Beltrami, Luca. Documenti e memorie riguardanti la Vita e le Opere di Leonardo da Vinci, in ordine cronologico, x + 222 p. Milano, Treves, 1919. 1818

Bilancioni, Guglielmo. Leonardo da Vinci e la fisiologia della respirazione. *Archivio di storia della scienza*, I, p. 157-174. Roma, 1920. 1818

Bottazzi, Filippo. Un esperimento di Leonardo sul cuore e un passo dell' Iliade. *Raccolta Vinciana*, X, p. 153-163. Milano, 1919. 1818

Favaro, Antonio. Passato, presente e avvenire delle edizione Vinciane, *Raccolta Vinciana*, t. 10, p. 165-219. Milano, 1919. 1818

Favaro, Antonio. Il posto di Leonardo nella storia delle scienze, *Scientia*, t. 26, p. 437-448. Bologna, 1919. 1818

Favara, Antonio. Difficultés que présente une édition des œuvres de Léonard de Vinci. *Nouvelle Revue d'Italie*, XVI[e] année, p. XVII XL. Rome, 1919. 1818

Favaro, Giuseppe. Leonardo e la topografia dorsale dei visceri. *Emporium*, t. 49, p. 280-281, 3 ill., 1919. 1818

Favaro, Giuseppe. Leonardo e l'embrologia degli uccelli. *Raccolta Vinciana*, t. 10, p. 141-151, 1919. 1818

Giacomelli, Raffaele. Gli studi di Leonardo sul volo. *Archivio di storia d. Scienza*, I, p. 174-176. Roma, 1920. 1818

Extract from the first part of a longer memoir in *L'Areonauta*, t. 2, p. 69-72, Roma 1919. The complete memoir will have 4 parts : Volo strumentale e volo animale; Volo per battimento d'ali; Volo senzer batter ali per favor di vento; Manovre di volo. G. S.

Holmes, C. J. Leonardo da Vinci. 28 p. Oxford University Press, for the British Academy. London, 1919. 1818

Short summary of Leonardo's work both in art and in science by the Director of the National Gallery. Ch. S.

Hopstock, H. Anatomen Leonardo. (Meddelelse tra Universitetets Anatomiske Institut), 85 p. Christiania, Steen, 1919. 1818

Summary in English p. 81-85. A translation of this paper will soon appear in Singer's Studies, vol. 2. G. S.

Horwitz, H. Th. Ein Problem Leonardo da Vinci's. *Geschichtsbl. f. Technik*, t. 3, p. 202-204, 330, 1916; t. 4, p. 83, 1917. 1818

Deals with a problem of statics. G. S.

Mazenta, Ambrogio. Le memorie di Leonardo da Vinci, ripubblicate ed illustrate da D. Luigi Gramatica, 72 p., in-4°. Milano, Alfieri e Lacroix, 1919. 1818

Micli, Aldo. Bibliografia degli scritti a stampa e delle riproduzioni dei manoscritti di Leonardo da Vinci. *Archivio di Storia della Scienza*, I, p. 177-185. Roma, 1920. 1818

Regnault, Félix. Les dessins de Léonard de Vinci. *Bull. Soc. franç. hist. méd*, t. 13, p. 478, 1914, 1818

Traces certain diseases in a series of grotesque heads by Leonardo. Ch. S.

Sarton, George. Une encyclopédie Léonardesque. *Raccolta Vinciana*, X, p. 235-242. Milano, 1919. 1818

Outline of the work undertaken by the author in 1918 for the Carnegie Institution of Washington. G. S.

Verga, Ettore. Regesti Vinciani. Quarta serie. *Raccolta Vinciana*, t. 10, p. 299-322. Milano, 1919. 1818

Chronological notes with brief indication of their sources, continuing those already publ. *ibidem*, II, III, VIII. A sharp and destructive criticism of Vegga's work has been published by Luca Beltrami in the two following pamphlets: Novissima Lezione Vinciana. Le « molteplici e faticose ricerche » del Direttore della Raccolta Vinciana. Parte prima (periodo, 1905-1913), 27 p. Milano, Tip. Allegretti, 1919. — Novissima lezione vinciana in due parti con intermezzo, XV + 91 p. *Ibidem*, 1919. G. S.

Verga, Ettore [*editor*]. Raccolta Vinciana presso l'Archivio storico del comune di Milano. Fascicolo decimo. Nel quarto centenario dalla morte di Leonardo da Vinci. Maggio MCMXIX. XII + 383 p. Milano, Castello Sforzesco, 1919. 1818

Contains an index to numbers 1 to 10, p. 329-383. G. S.

S. XVI

Capparoni, Pietro. Per l'armamentario chirurgico del secolo XVI (nota preventiva) *Rivista di stor. crit. d. sci.*, t. 8, p. 331-339, 5 fig., 1917. 1818

Corsini, Andrea. Andrea Vesalio nello studio di Pisa. Estratto dal vol. pubblic. nel XXX anno di Direzione sanitaria del Prof. D. Barduzzi delle RR. Terme di S. Giuliano 1915, 21 p. Siena, Tip. S. Bernardino, 1915. 1818

Deichert, H. Die Einführung der Radix Ipecacuanha. *Arch. f. Gesch. d. Med.* XI, p. 292, 1919. 1818

The discovery of Ipecacuanha or at least its announcement is usually referred to the first half of XVII[th] cent. The first certain refer. is in a Natural Hist. of Brazil by PISO OF LEYDEN printed in 1648. The author gives reason for thinking that the root was known to CLUSIUS (1526-1609) when he translated the work of the Spaniard NIC. MONARDIS (d. 1578).
C. S.

De Toni, G. B. Spigolature Aldrovandiane XIV : Cinque lettere inedite di ANTONIO COMPAGNONI di Macerata ad ULISSE ALDROVANDI. *Riv. d. stor. crit. d. sci*, t. 6, p. 479-486, 1915. 1818

De Toni, G. B. Spigol. Aldrov. XVII : Lettere inedite di FRANCESCO BAROZZI [Candia, 1537-Venezia, 1604], matematico del secolo decimosesto. *Ateneo Veneto*, anno XL, vol. II, 12 p. Venezia, 1917. 1818

Contains also a list of Spig. Aldrov,, I-XVII, 1902-1917. G. S.

De Toni, G. B. Notizie bio-bibliografiche intorno EVANGELISTA QUATTRAMI [Gubbio 1527 - m. dopo 1601], semplicista degli Estensi. *Atti del R. Istit. Veneto*, t. 77, parte 2[da], p. 373-396. Venezia, 1918. 1818

[**Eustachio, Bartolomeo**]. Un ricordo in bronzo a BARTOLOMEO EUSTACHI nell'Università di Roma. *Riv. d. St. crit. d. sci.*, t. 6, p. 616; 1915. 1818

Statue by GIUS. TONINI dedicated on Nov. 11, 1914, bearing the inscription : « BARTHOLOMAEO EUSTACHIO — Picenti — Artis anatomiae lumini — Senatus academicus — quartis feriis secularibus — anno MDCCCCXIV. »
G. S.

Fossel, V. Von der Heilkraft der Kröte in den Schriften alterer Aerzte. *Arch. f. Gesch. d. Med.*, t 8, p. 39; 1914. 1818

Traces the herblore of the ancients into the work of the physicians of the late Renaissance. C. S.

Gerster, K. Bücher aus KONRAD GESNERS Bibliothek. *Mit. zur Gesch. d. Med.*, t. 15, p. 370-371; 1916. 1818

Giordano, D. AMBROGIO PARÉ, Ugonotto. *Riv. d. st. crit. d. sci.*, t. 6, p. 559 571, 591-605 ; 1915 1818

A propos of EDW. A. MALLON's papers in the *Records of the Amer. Catholic histor. soc.*, p. 332-347 ; 1913.

Guicciardini, Francesco [1483-1540]. La Storia d'Italia. Edizione definitiva sugli originali manoscritti. 4 vol. in-8° gr. con scritti del Conte FRANCESCO GUICCIARDINI, di ISIDORO DEL LUNGO, ALESSANDRO GHERARDI ed ENRICO ROSTAGNO, tre ritratti e due facsimili. Firenze, SANSONI, 1919. 1818

Heinrich, C. Die Lehre vom Starr bei GEORG BARTISCH (1535-1606). Jenaer medizin-histor. Beitraege, Heft 6, p. 43. Jena, 1916. 1818

The original German text, 1583, of the court oculist GEORG BARTISCH, is reproduced and the operation described. Also a disquisition on the doctrine of cataract at the Renaissance. C. S.

Horwitz, Hugo Theodor. Techniches in der Lebensgeschichte des Benvenuto Cellini. *Mit. zur Gesch. d. Med.*, t. 17, p. 186-190; 1919. 1818

Liesegang, F. Paul. Die Kamera obskura bei Porta. *Mit. zur Gesch. d. Med.*. t. 18, p. 1-6; 1919. 1819

Lippmann, Edm. O. von. Zur Geschichte der ununterbrochenen Kühlung bei der Destillation. *Chemiker Zeitung*, p. 1. Reprint, 10 p. Cöthen, 1915. 1818

Lippmann, Edm. O. von. Uber das Zeitalter der Alchemisten J. I. und I. Hollandus. *Chemiker Zeitung*, p. 605. Reprint, 2 p. Cöthen, 1916. 1818

The oldest historians of chemistry assumed that these two alchemists lived in XIV or beg. of XV; the 4th ed. of Meyer's Hist. (1914) still contains this view. Now Sudhoff had already suggested that the Chym. Trakt. of Isaak Hollandus supposed to have been written before 1450, was a post-Paracelsian writing. According to Ben Jonson in his « Alchemist », 1610, Joh. Isaak H. died in or ab. 1610, while I. H. was still living at that time. Bergmann (Beitr. z. gesch. d. Chemie 1782) had already spoken of the Hollandi as living « circa initium saeculi XVII ». G. S.

Lippmann, Ed. O. von. Ueber die unter dem Namen der « Hollandi » bekannten Alchemisten. *Chemiker Zeitung*, N° 58. Reprint of 19 p. Cöthen, 1919. 1818

More thorough study of the question than L.'s preceding one (1916). The conclusions are: no pre-Paracelsian writer knows anything ab. the Hollandi chemical works; altough Paracelsus is not quoted by the H., their writings are essentially derived from the Paracelsian lit. First known H. printed work: 1572; 2d, 1582; 3d, 1600. There were at least two authors called Hollandus, presumably father and son; the oldest I. I H. died not long bef. 1610; the youngest I. H. was still living at that time; they lived in Antwerp. G. S.

Morley, Frank V. Finis coronat opus. *Scientific Monthly*, X, 306-308. New York, 1920. 1818

About Robert Recorde's lamentable death in 1558 at the Fleet prison, London. G. S.

Neuburger, Max. Eugenik auf grund der Temperamentenlehre. *Mit. zur Gesch. d. Med. u. Naturw.*, t. 16, p. 433-435; 1917. 1818

Extracts from Huarte (1520-bef. 1592), Exámen de ingenios para las sciencias. G. S.

Neumann, Felix. Leonhard Fuchs, physician and botanist, 1501-1566. *Report of Smithsonian Institution for 1917*, p. 635-647, with 7 plates, Washington, 1919.

Regnault, Félix. Sur une cause de propagation de la syphilis au XVIe siècle. *Bull. Soc. franç. hist. méd.*, t. 13, p. 31; 1914. 1818

Treats of the public baths and their wide spread in XVI. These places were often little better than brothels. C. S.

Simpson, George Eric. The Haven of Health. *Scientific Monthly*, X, p. 26-37. New York, 1920. 1818

About a book of same title publ. in 1584 (or 1586) by Thomas Cogan (1547-1607), physician and schoolmaster of Manchester. Second ed. cor-

rected and improved in 1589, later ed. 1596, 1605, 1636. COGAN died in 1607, bequeathing « to every scholler of the ffree schoole in Manchester, 4 d. a peece... » G. S.

Sudhoff, Karl. Der Stöckelsche Nachdruck der PELIGKSHEN « Compendiosa capitis physici declaratio » von 1510. *Arch. f. Gesch. d. Med*, X, p. 251; 1917. 1818

Describes the evolution in Renaissance time of certain mediaeval physiological conceptions. C. S.

Viana, Odorico. L'atto di ammissione del FRACASTORO al collegio medico di Verona. *Riv. storia crit. d. sci.*, V, p. 382-383; 1914. 1818

This document dated 18 Sept. 1505 is reproduced in extenso. G. S.

Wieleitner, H. [GIAMBATTISTA] BENEDETTI [1530-1590] als Perspektiviker. *Mit. zur Gesch. d. Med.*, t. 17, p. 190-195; 1919. 1818

Zaccagnini, Guido. Della vita e delle opere di BERNARDINO BALDI [1533-1617]. Reggio Emilia, Tip. d. Coll. storico letterario, 42 p.; 1918. 1818

Zaunick, Rudolph. JOHANNES KENTMANN, 21. April 1518 bis 14. (oder 15.) Juni 1574. *Mit. zur Gesch. d. Med.*, t. 18, p. 177-183; 1919. 1818

A Saxon naturalist and physician, a friend of GESNER. GESNER obtained from him much information. G. S.

S. XVII

Ahrens, W. Zur Geschichte der Münchener Originalluftpumpe OTTO VON GUERICKE'S. *Geschichtsbl. f. Technik*, t. 3, p. 200-202; 1916. 1818

Archibald R. C. NAPIER's Descriptio and Constructio. *Bull. Am. math. Soc.*, vol. 22, p. 182-187; 1916. 1818

Very detailed review of the booklets on NAPIER by E. W. HOBSON and G. A. GIBSON, 1914. See *Isis*, III, p. 110, also p. 283. J.

Baglioni, S. Due osservazioni di fisiologia comparata dei pesci di FRANCESCO REDI. *Riv. stor. crit. Sci.*, t. 7, p. 75-79; 1916. 1818

Baroncini, Raffaele. I libri e le preparazioni anatomiche dell Dott. ANT. MARIA VALSALVA. *Riv. stor. crit. Sci.*, t. 5, p. 355-365; 1914. 1818

Bigourdan, G. Les premières sociétés scientifiques de Paris au XVII^e^ siècle. Les réunions du P. MERSENNE et de l'Académie de MONTMOR. *Comptes Rendus de l'Acad. des Sci.*, t. 164, p. 129-134, 159-162, 216-220. Paris, 1917. 1818

Bigourdan, G. Sur quelques anciens observatoires de la région provençale au XVII^e^ siècle. *Comptes Rendus*, t. 164, p. 253-259. Paris, 1917. 1818

D'autres notes sur des observatoires français (Paris et province) au XVII^e^ siècle ont été publiées par le même auteur, *Ibidem*, p. 322-328, 375-380, 461-467, 537-543. G. S.

Bigourdan, G. Sur les observations attribuées au prince Louis de Valois et sur l'astronome Jacques Valois *Comptes Rendus*, t. 164, p. 975-979. Paris, 1917. 1818

Les observations astronomiques attribuées à Louis-Emmanuel de Valois (1596-1663), petit-fils de Charles IX et gouverneur de Provence de 1637 à 1650, sont en réalité de Jacques Valois (1582-1654), un Ecossais qui devint trésorier général de France à Grenoble. Il était lié avec Snellius et Gassendi. C'était plutôt un astrologue qu'un astronome. G. S.

Bigourdan, G. Un astronome jardinier au XVII^e^ siècle. Elzéar Féronce. *Comptes Rendus*, t. 165, p. 84-88. Paris, 1917. 1818

Commença ses observations à Vizille, en 1622. G. S.

Brieger, Walter. Zur Lebensgeschichte Johann Rudolph Glaubers. *Geschichtsblätter f. Technik*, V, p. 53-70; 1918. 1818

Born 1603 or 1604 in Karlstadt, Franconia, died 1670 (not 1668) in Amsterdam. G. S.

Burns, C. Delisle. Leibniz's Life and Work. *Monist*, vol. 26, p. 486-503. Chicago, 1916. 1818

Burns gives an account of Leibniz's life, and lays particular stress on those activities of his which are of more general interest, such as the great part he took in founding Academies. J.

Burns, C. Delisle. Leibniz and Descartes. *Monist*, vol. 26, p. 524-533, Chicago, 1916. 1818

Burns attempts to estimate : (1) The dependence of Leibniz upon Descartes for his conceptions of method; 2. his relation to Descartes in psychological questions; and 3. his dependence upon the Cartesian mechanism in physical science. J.

Cajori, Florian. On the history of Gunter's scale and the slide rule during the seventeenth century. University of California Public. in Mathematics, vol. 1, p. 187-209. Berkeley, 1920. 1818

Complement to C.'s previous writings on the history of the slide rule (1909-1910). Contains : (1) some details of the changes introduced during XVII^th^ cent. in the design of Gunter's scale by Edmund Wingate, Milbourn, Thomas Brown, John Brown and Will. Leybourn; (2) account of Richard Delamain's Grammelogia of 1630 on the slide rule which antedates Oughtred's first publ. (though O.'s date of *invention* is earlier than the date of Delamain's alleged invention) and of Delamain's later designs of slide rules; (3) account of the controversy between Oughtred and Delamain; (4) account of a later book on the slide rule written by Will. Oughtred, his gauging line of 1633 and of XVII^th^ cent. slide rules. G. S.

Cajori, Florian. A list of Oughtred's mathematical symbols with historical notes. University of California Publications in Mathem., I, p. 171-186. Berkeley, 1920. 1818

Study of the symbols used by O. in the various ed. of his Clavis and other public. It is of special importance because of the extraordinary emphasis laid by O. upon the invention and use of mathematical symbols at a period when algebraic symbolism was in a state of formation. — Also bibliogr. study of O.'s works, espec of the various Latin and English ed of his Clavis (the Key of the Mathematics). Latin ed. of the Clavis : 1631, 1648, 1652, 1667, 1693, 1698. English ed. : 1647, 1694, 1702 (the latter a new title-page ed.). G. S.

Cajori, Florian. WILLIAM OUGHTRED. A great seventeenth-century teacher of mathematics. VI + 100 p. Chicago and London, Open Court, 1916. 1918

This book is a reprint of articles in the *Open Court* and the *Monist* for 1915. OUGHTRED's writings and symbolism are fully described and his influence on the development and teaching of mathematics are discussed. J.

Cajori, Florian. LEIBNIZ's « Image of Creation ». *Monist*, t. 26, p. 557-565. Chicago, 1916. 1918

An account of the shape which LEIBNIZ's discovery and advocacy of the binary system of numeration in arithmetic took in his mind. LEIBNIZ held that binary arithmetic was an « image of creation ». J.

Capparoni, Pietro, Otto lettere di ANTONIO VALLISNIERI [Tresilico, G. D. di Modena, 1661-1710]. *Riv. stor. crit. sci.*, t. 8, p. 291-315 ill.; 1917. G. S. 1918

With biogr. and bibliogr. notes.

Capparoni, Pietro. Una lettera inedita di MANFREDO SETTALA. *Riv. stor. crit. sci.*, t. 5, p. 348-350; 1914. 1918

MANFREDO SETTALA was a naturalist who like FED. CESI and KIRCHER made a collection of various curiosities. This collection, « Museo Settaliano » is now kept in a separate room of the Ambrosiana, Milano. G. S.

Capparoni, Pietro. Il Calamaio di ATANASIO KIRCHER [1601-1680]. *Riv. stor. crit. sci.*, t. 6, p. 345-354, ill.; 1915. 1918

Contains also biogr. and bibliogr. notes concerning KIRCHER. G. S.

Carslaw, H. S. The discovery of logarithms by NAPIER. *Math. Gaz.*, vol. 8, p. 76-84, 115-119; 1915. 1918

In the first place a very full description of N. 's method of constructing his table of logarithms is given, based on N. 's *Constructio* of 1619, which was written, at least in part, before the publication of the *Descriptio* of 1614. N. obtained the idea of a logarithm from a correspondence between an arithmetical and a geometrical series and the word «logarithm» is easily seen to be derived from « the number of the ratios » required in working with such a correspondence. But when N. came to define his logarithms in general, he took a new point of view altogether, and considered two points flowing along two straight lines with certain corresponding velocities. Though his logarithms nearly agree with those previously defined, they do not do so absolutely. In the second part of the article is described how N. completed his tables, an account is given of what N. called « another and better kind of logarithms », and BRIGG's work is shortly referred to. This paper is of great value as throwing light on the way in which N. discovered his logarithms. J.

Child, J. M. ISAAC BARROW, the drawer of tangents. *Open Court*, vol. 30, p. 65-69. Chicago, 1916. 1918

After a short summary of the life of ISAAC BARROW (1630-1677), CHILD suggests reasons for the unfair estimate of his mathematical work formed by the continental mathematicians of the present day. BARROW's reading, training, and disposition tended to make him a geometrician, with a dislike for the analytical method of DESCARTES He recognized in NEWTON a genius

peculiarly adapted to analysis, and this, together with his determination to forsake mathematics for divinity, resulted in his making no attempt to complete the work that he had so well begun. Thus, properly to estimate BARROW'S place in the history of mathematics, we must read into his work what might have been got out of it. The article is illustrated by a reproduction, (described on p. 126) from a painting of BARROW in Trinity College, Cambridge. J.

Child, J. M. The Manuscripts of LEIBNIZ's on his discovery of the differential calculus. *The Monist*. vol. 26, p. 577-629, 1916. 1818

Translation, with very lengthy annotations, of (1) The cancelled postscript (first published by C. I. GERHARDT) of a letter written by LEIBNIZ to JACOB BERNOULLI in April, 1703, which deals with LEIBNIZ's early studies in mathematics; (2) C. I. GERHARDT's publication of 1846 (Hanover) entitled *Historia et Origo Calculi Differentialis, a G. G. Leibnitio Conscripta*. J.

Child, J. M. The Manuscripts of LEIBNIZ on his discovery of the differential calculus. Part II. *The Monist*, vol. 27, p. 238-294; 1917. 1818

This translation of the manuscripts written by LEIBNIZ in the years 1673-1675 continues the translation mentioned above. The well-known publications of GERHARDT of 1848 and 1855 are here used as originals, and the translations are carefully arranged and annotated. J.

Duhem, Pierre. L'optique de MALEBRANCHE. *Revue de Métaphysique et de Morale*, p. 37-91 du numéro spécial consacré à MALEBRANCHE à l'occasion du deuxième centenaire de sa mort. Paris, 1916. 1818

Favaro, Antonio. I successori di GALILEO nello studio di Padova fino alla caduta della Repubblica, 89 p. Venezia, *Nuovo Archivio Veneto*, 1917. 1818

Feldhaus, F. M. PASCALS Rechenmaschine. *Geschichtsblaetter f. Technik*, t. 5, p. 149-151; 1918. 1818

Feldhaus, F. M. Zur Geschichte des Gasometers. *Geschichtsblaetter f. Technik*, t. 5, p. 85-86, 1 Abb.; 1918. 1818

The invention of both laboratory and industrial gasometers is generally attributed to LAVOISIER 1787. This apparatus however was already used by HUYGENS before 1687. See: Machines et Inventions approuvées par l'Acad. Royale des Sciences, t. I, n° 18, Paris, 1735. G. S.

Fritz, Felix. Zur Geschichte der Entdeckung der Lichtempfindlichkeit der Silbersalze, *Chemiker Zeitung*, t. 38, p. 246-247 Cöthen, 1914. 1818

The first to notice the blackening of silversalts was not J. H. SCHULZE in 1727, but W. HOMBERG in 1694. G. S.

Garboe, Axel. Ein Beitrag zur Geschichte der dänischen Edelsteinkunde im 17. Jahrhundert. *Mit. zur Gesch. d. Med.*, t. 15, 197-199; 1916. 1818

Experiment made in 1668 by CHRISTIAN V of Denmark to see whether diamond was really indestructible by hammering as an old superstition would have it. G. S.

Giovannozzi, P. Giovanni. Pierre Fermat. Una lettera inedita. *Archivio di storia della scienza*, I, p. 137-140. Roma, 1920. 1818

Letter of P. F. to Pierre de Brulart de Saint Martin on his method *de maximis et minimis*, dated May 31 (?) 1643, found in the Biblioteca Nazionale, Firenze. This letter was quoted as missing in the Œuvres de F., II, p. 253-256. Paris, 1894. G. S.

Haentzschel, E. Eine von Newton gestellte Aufgabe über Sehnenvierecke. *Z. f. math. u. naturw. Unterricht*, Bd. 46, p. 190-194, 1915. 1818

Haeussler, E. P. Beschreibung eines Pulsmessers (Sphygmaticum) aus dem Anfange des 17. Jahrh. *Mit. zur Gesch. d. Med.*, t. 14, p. 106-109, 1915. 1818

Instrument described by Daniel Schwenter. Deliciae Physico-mathematicae, Nürnberg, 1636, p. 415-416. G. S.

Haeussler, E. P. Weiteres über das Pendel, das Sphygmaticum und die « Mathematischen und Philosophischen Erquickstunden ». *Mit. zur Gesch. d. Med.*, t. 14, p. 165-168, 1915. 1818

From G. Ph. Harsdörffern. Delitiae mathematicae et physicae der mathem. u. philos. Erquickstunden zweyter Teil, Nürnberg 1651, a sequel to Schwenter's book of 1636. G. S.

Hathaway, Arthur S. The discovery of the calculus. *Science*, t. 50, p. 41-43; t. 51, p. 166-167. New York, 1919-1920. 1818

To show Leibniz's bad faith in his controversy with Newton. G. S.

Horwitz, H. Th. Eine Datierung des Veranzio. *Geschichtsbl. f. Technik*, t. 3, p. 81-82, 1916. 1818

What is the date of the Machinae Novae of Faustus Verantius (1551-1617) published in Venice : is it ca. 1595, 1617, 1620? G. S.

Jourdain, Philip E. B. The Principles of Mechanics with Newton from 1679 to 1687. *The Monist*, vol. 24, p. 515-564. Chicago, 1914. 1818

See *Isis*, II, 209. This second part of the author's investigations begins with the important correspondence between Hooke and N. which turned N. thoughts again to the subject of gravitation. It is pointed out that the application of the propositions discovered by N. in 1679 to the actual universe was only possible with accuracy when N. determined (1685) the attraction of a sphere on an external particle. N. investigations in 1684 and 1685 are then dealt with, and the first drafts of the *Principia* in the Cambridge University Library have been subjected to a careful examination. An extract from an early manuscript of N. in the same library is then given, on account of the clear expression in it of the conception of mass as quantity of matter, and some passages from the *Principia*, and from N. published correspondence with Cotes on the occasion of the preparation of the second edition of the *Principia*, showing the instinctive origin of the Third Law of Motion. Finally, Rosenberger's (1895) conclusion that N. considered mass to be proportional to the number of the homogeneous particles of matter is discussed and, in essentials, accepted. J.

Jourdain, Ph. E. B. John Napier and the tercentenary of the invention of logarithms. *Open Court*, vol. 28, p. 513-520 (with portrait), 1914. 1818

The first publication of logarithms by N. (1550-1617) was in 1614, and an

account of the work that was done in the same direction by NICOLAS CHUQUET and JOBST BÜRGI is given. Much of the information is obtained from G. A. GIBSON, « N. and the Invention of Logarithms », *Proc. Roy. Soc. of Glasgow*, 1914, p. 3-24, and J. W. L. GLAISHER, « N », *Encyc. Brit.*, 11th edition, 1911, XIX, p. 171-175. N. devised many means for shortening calculations, of which logarithms are by far the most ingenious and valuable. The work of HENRY BRIGGS (1556-1630) is also shortly referred to. J.

Jourdain, Ph. E. B. The logical work of LEIBNIZ. *The Monist*, vol. 26, p. 504-523. Chicago, 1916. 1818

This account of L.'s logical work is, in great part, based on L. COUTURAT'S Logique de L. of 1901, but on some important points COUTURAT'S account is supplemented. This is so in the account (§ II) of the early appearance of L.'s doctrine that the principle of identity holds a very fundamental place in logic; in the sections (§§ IV, V) on the influence which guided L. to a study of mathematics and on his mathematical work down to about the end of 1676; in the account (§ X) of the « principle of continuity » and its later developments; and in numerous footnotes throughout the paper. J.

Kistner, Adolf. Zur Benutzung der Pendels als Pulsmesser am Anfang des 17. Jahrh. *Mit. zur Gesch. d. Med.*, t. 14, p. 240-242, 1915. 1818

Discussion of HAEUSSLER'S papers publ. *ibidem*. K. shows that SCHWENTER'S sphygmaticum was a poor reinvention of an instrument (pulsilogium) described by SANTORIO in his Commentary on AVICENNA 1626. SANTORIO devised 3 different models of pulsometer. G. S.

Klinckowstroem, Carl von. Ein Petroleumleitung von 1665. *Geschichtsbl. f. Technik*, t. 3, p. 11-12, 1 Abb., 1916. 1818

In ATH. KIRCHER, Mundus Subterraneus, vol. 2, p. 73-74, 1665. G. S.

Klinckowstroem, Carl von. Ein bisher verschollene Luftpumpe OTTO VON GUERICKES. 4 Abb. *Geschichtsbl. f. Technik*, t. 3, p. 196-200, 1916. 1818

Leibniz, Gottfried Wilhem. New Essays concerning Human Understanding. Together with an Appendix consisting of some of his shorter pieces. Translated from the original Latin, French and German, with notes by ALFRED GIDEON LANGLEY. Second edition. XX + 862 p., portrait of LEIBNIZ. Chicago and London, The Open Court Publishing Company, 1916. 1818

This is an unaltered reprint of the first edition, which was published in 1896 (New York and London), and consists of a translation of the entire fifth volume of GERHARDT'S *Philosophischen Schriften von Leibniz*, and an appendix of short pieces bearing on the subjects discussed in the body of the work. There were and are very many mistranslations, some of which were pointed out in *Mind*, XXIII, p. 420, 1897. J.

Loria, Gino. EVANGELISTA TORRICELLI nella storia della geometria. *Rendiconti delle sedute d. R. Accad. d. Lincei, sci. fis.*, vol. 28, p. 409-415. Roma, 1919. 1818

Mieli, Aldo. La teoria chimica generale da JEAN REY ad ANTOINE LAURENT LAVOISIER. *Riv. stor. crit. Sci.*, t. 7, p. 110-117; 1916. 1818

A propos of DUHEM. La chimie est-elle une science française? Paris, 1916. G. S.

Power, Sir D'Arcy. The Oxford physic garden. *Annals of medica history*, t. 2, p. 109-125, 7 ill. New York, 1919. 1818

Notes derived from the commonplace books of the Rev. JOHN WARD (Mss. of the Medical Library, London) on himself, RICHARD LOWER, JACOB BOBART, gardner of the Oxford physic garden opened in 1621, ROBERT MORISON (1620-1683), EDWARD MORGAN, ROBERT DALE, CHRISTOPHER MERRITT (1614-1695). G. S.

Singer, Charles. Notes on the early history of microscopy. *Section of the hist. of med., Proceedings R. S of Med.*, VII, p. 247; 1914. 1818

Traces the invention of the instrument and the earliest discoveries made with its aid. Numerous figures. C. S.

Torricelli, Evangelista [1608-1647]. Opere edite in occasione del III centenario della nascita col concorso del Comune di Faenza, da GINO LORIA e GUISEPPE VASSURA. Faenza, G. MONTANARI, 1919. 1818

Vol. I. Geometria. (LORIA) XXCIII + 407 + 482 p.; vol. II, Lezioni accademiche. Meccanica. Scritti vari (VASSURA), 320 p.; vol. III, Racconto d'alcuni problemi. Carteggio scientifico (VASSURA). I have seen only the introduction by LORIA, divided as follows: (1) Ad uno svolto della storia; (2) Alunnato e noviziato di T.; (3) Il periodo fiorentino (with a very interesting list of the scientific books in T.'s library); (4) La morte; (5) Le disposizioni testamentarie; (6) Alla ricerca d'un editore; (7) Vicissitudini subite dai mss. tor.; (8) Public. parziali; (9) Risorge il progetto d'un' ed. completa; (9-12) La presenta ed. G. S.

Vram, Ugo G. Sull' Antropometria [Padova 1654] di GIOVANNI SIGISMONDO ELSHOLZ [1623-1688]. *Riv. stor. crit. Sci.*, t. 6, p. 356-369; 1915. 1818

Wieleitner, Heinrich Ueber die ursprüngliche Form des PASCALschen Lehrsatzes. *Mit. zur Gesch. d. Med.*, t. 14, p. 157-162; 1915. 1818

Wormser. Ueber den Läufer an Rechenschiebern. *Mit. zur Gesch. d. Med.*, t. 18, p. 6-9; 1919. 1818

The runner of a slide ruler was not introduced by NEWTON 1675 (as CAJORI would have it) nor by STONE 1734, but by one JOH. MATHAEUS BILER 1696 whose device is described in LEUPOLD, Theatrum arithmetico-geometricum, 1727, p. 77, pl. XIII. G. S.

Zaunick, Rudolf. Eine handschrifliche Mitteilung von G. E. RUMPH über die Korallenbauten. *Mit. zur Gesch. d. Med.*, t. 14, p. 330-332; 1915. 1818

Ms. in the Royal Public Library, Dresden (B 110) of G. E. RUMPH (1627-1702). It is a catalogue of natural curiosities sent in 1682 to COSIMO III DE' MEDICI. The part of it dealing with corals is here reproduced. G. S.

S. XVIII

Bilancioni, Guglielmo. La morte e la successione del MORGAGNI agli occhi di un anatomico contemporaneo. *Riv. stor. crit. Sci.*, t. 6, p. 487-509; 1915. 1818

Reminiscences about MORGAGNI extracted from the unpublished corres-

pondance (with GIOV. BIANCHI) of a younger colleague of his at the Univ. of Padova, LEOP. MARC ANTONIO CALDANI (Bologna 1725-1813) with biogr. and bibliogr. notes concerning the latter. G. S.

Chalmers, A. J and **Archibald R. G.** Two early XVIII[th] century treatises on tropical medicine. *Section of the hist. of med., Proc. R. S. Med.*, t. 7, p. 98. London, 1914. 1818

The books dealt with are interesting because they enable us to identify the following diseases in the early XVIII. In South America : Dracontiasis, Dermatophiliasis, Epidemic gangrenous rectitis. In India : Simple continued fever, Malarial fevers, Cholera, Dysenteries, Climatic bubo. In West Africa : Malarias, Endemic yellow fever, Dengue, Filariasis, Yaws. C. S.

Cushny, A. R. WILLIAM WITHERING [1741-1799]. *Proc. R S. Med , hist. section*, t. 8, p. 85-94. London, 1915. 1818

Tells of the discovery of digitalis as a therapeutic agent and how folk medicine first drew WITHERING's attention to it. C. S.

Fehlering, Hans, SWEDENBORGS Studie über das Fallen und Steigen des Wenersees. *Mit. zur Gesch. d. Med.*, t 18, p. 10 17; 1919. 1818

German transl. with commentary of a paper written by SWEDENBORG in 1719-1720. SWEDENBORG was then the first to express the view that the amount of water decreases in the N. part of Europe; cfr. ANDREAS CELSIUS 1743, also SUESS, Antlitz, II, p. 9 sq. G. S.

Feldhaus, F. M. Der älteste Militärballon. *Geschichtsbl. f. Technik*, t. 4, p. 76-79, 2 Abb.; 1917. 1818

Balloon abandoned by the French after the battle of Würzburg 1796, Sept. 3, now in the military museum of Vienna; most likeky one of 4 oldest military balloons. Such were used first by the Austrians in 1793, next by the French in 1794 (Maubeuge, Fleurus). The balloon now kept in Vienna is supposed to be the « Entreprenant » first used at Fleurus 1794. G. S.

Good, Harry G. BENJAMIN RUSH and his services to American education, x+283 p. Berne, Indiana, Witness Press, 1918. 1818

Guenther, Siegmund. Wann entstand die erste wissenschaftliche Theorie des Polarlichtes. *Mit. zur Gesch. d. Med.*, t. 14, p. 231-240; 1915. 1818

The first to offer a scientific therry of the aurora borealis was the Norvegian JENS KRISTIAN SPIDBERG (1684-1762). Of course this was a purely optical theory. G. S.

Johnston, G. A. The influence of mathematical conceptions on BERKELEY's philosophy. *Mind*, vol. 25, p. 177-192. Aberdeen, 1916. 1818

In this paper B.'s contributions to mathematics are not dealt with, but two respects are indicated in which his philosophy was affected by attempts to « apply » mathematical conceptions. By making use of recently discovered methods of calculation by symbols, which had a great influence on the thought of his day, B. sought to give an explanation of Nature and its laws by means of the relation of sign and thing signified, and thus to establish an Algebra of Nature; and he endeavoured to develop an Algebra of Ethics by applying algebraic methods to the problems of morality. J.

Klinckowstroem, Carl von. Emanuel Swedenborg und das Flugproblem. *Geschichtsbl. f. Technik*, t. 3, p. 207-217, 303-312, 4 Abb.; 1916. 1818

Lippmann, Edm. O. von. Franz Karl Achard [1753 1821], der Begründer der Rübenzucker-Industrie. *Geschichtsbl. f. Technik*, t. 3, p. 2-8; 1916. 1818

Same author has also published extracts from Achard's correspondance in *Die Deutsche Zuckerindustrie*, Berlin, 1915, 1920. G. S.

Merbach, Paul Alfred. Allerlei Technisches im Briefwechsel [1775-1828] des Herzogs-Grossherzoges Carl August mit Goethe. *Geschichtsbl. f. Technik*, t. V, p. 129-137; 1918. 1818

Niemann, W. [Aimé] Argand [1750-1803] und die Erfindung der Lampe mit doppeltem Luftzug. *Geschichtsbl. f. Technik*, t. 4, p. 7-24; 1917. 1818

Osler, William. Currie's Journal. *Annals of medical history*, t. 2, p. 81. New York, 1919. 1818

About the Ms. Journal of the Scotch physician James Currie (1756-1805), editor of Burns and author of an excellent work in 2 vol. « Medical reports on the effects of water », 1797. This Ms. was bought at Sotheby's in 1918 by the Liverpool Public Library. G. S.

[Priestley, Joseph]. The House of Joseph Priestley [1733-1804]. *Science*, vol. 50, p. 495. New York, 1919. 1818

Priestley came to America in 1794. His house and laboratory at Northumberland, Pa. was purchased recently by graduate students of the Pa. State College who plan to move it to the campus and make of it a lasting memorial. G. S.

Rivière, Madame Mg. J. James Watt. Son rôle dans le développement de la machine à vapeur. *Revue générale des Sciences*, t. 30, p. 644-648. Paris, 1919. 1818

Simpson, Sir Alexander. Jean Astruc [1684-1766]. *Proc R. S. of Med., hist. section*, t. 8, p. 59; 1915. 1818

Jean Astruc, the father of textual biblical criticism, was also one of the best XVIII^th^ cent. writers on venereal disease. His bibliography of that subject is still of value. C. S.

Speyerer, Kurt. Goethes physikalische Sammlungen im Neubau des Weimarer Goethehauses. *Geschichtsbl. f. Technik*, t. 1, p. 134-142; 1914. 1818

Stein, Robert. Ein Keim des natürlichen Systems der chemischen Elemente in einer Bemerkung von Görres um 1800. *Mit zur Gesch. d. Med.*, t. 15, p. 5-9; 1916. 1818

J. Görres in his preface to the German transl. of Fourcroy, Tableaux synoptiques de Chimie, Koblenz, Jahr IX (*i. e.* 1800-1801). G. S.

Stein, Robert. Ein eigenartiger Leitfaden der Chemie v. J. 1800 (Fourcroy's synoptische Tabellen). *Mit. zur Gesch. d. Med.*, t. 14, p. 297-314; 1915. 1818

A study of the works of Antoine François Fourcroy (Paris, 1755-1809) and especially of his « Tableaux synoptiques de Chimie, Paris, an VIII ». Fourcroy was to Lavoisier what Christian Wolf was to Leibniz. G.S.

Stein, Robert. Naturgeschichts-Unterricht im 18. Jahrh. und GOETHES botanisches Studium. *Mit. zur Gesch. d. Med.*, t. 16, p. 135-142; 1917. 1818

Stein, Robert. Uebersichtstafeln für Natur- und Heilkunde (1735-1835). *Mit. zur Gesch. d. Med.*, t. 15, p. 89-101; 1916. 1818

List of works offering synthetic surveys of various branches of science in tabular form. G. S.

Van Leersum, E. C Two of BOERHAAVE's lecture lists. *Proc. R. S of Med., hist. section*, XI, p. 11; 1918. 1818

Illustrates the cosmopolitan character of B.'s audiences. C. S.

Warren, J. Collins The « Pulmotor » of the XVIII[th] century. *Annals of medical history*, t. 2, p. 14-20, 210, 4 ill. New York, 1919. 1818

Rectal insufflation of tobacco to revive drowned people. G.S.

S. XIX

A. — *Mathematics*

Birkhoff, George D. Recent advances in Dynamics. *Science*, t. 51, p. 51-55, New York. 1920. 1818

Progress of celestial mechanics with special reference to JACOBI, G. W HILL, BURNS, POINCARÉ, LEVI-CIVITA and SUNDMAN. G. S.

Bolyai, John [1802-1860]. The Science Absolute of Space, Independent of the Truth or Falsity of EUCLID's Axiom XI (which can never be decided *a priori*). Translated from the Latin by G. B. HALSTED. New Edition, XXX+71 p. Chicago and London, The Open Court Publishing Co., 1914. 1818

This translation, originally published as the third volume of the « Neomonic Series », attained its fourth edition in 1896 (Austin, Texas, U. S. A.). The present reissue is unaltered. J.

Cantor, Georg. Contributions to the Founding of the Theory of Transfinite Numbers. Translated, and provided with an Introduction and notes, by PHILIP E. B. JOURDAIN. N° 1. of « The Open Court Classics of Science and Philosophy » X+211 p. Chicago and London, The Open Court Publishing Company. 1818

A translation of GEORG CANTOR's two important « Beiträge zur Begründung der transfiniten Mengenlehre » (*Math. Ann.*, t. 46, p. 481-512, 1895; t. 49, p. 207-246, 1897) is here given (p. 85-201), and prefaced by a very full historical introduction (p. 1-82) on the previous work of C. and of his predecessors. Parts of the introduction have appeared in JOURDAIN's articles in the *Archiv der Math. und Phys.* (3) (t. 10, p. 254-281, 1906; t. 14, p. 289-311, 1909; t. 16, p. 21-43, 1910; t. 22, p. 1-21. 1913) and *Isis*, (t. 1, p. 661-703, 1914). Some notes (p. 202-208) contain indications of the progress made in the theory of transfinite numbers since 1897. An index completes the volume. J.

Goldenring, Robert. Die elementargeometrischen Konstruktionen des regelmässigen Siebzehnecks. Eine historisch-kritische Darstellung, 69 p., 51 fig. Leipzig, TEUBNER, 1915. 1918

See a very detailed and learned review, in which several additions are suggested, by R. C. ARCHIBALD, *Bull. Amer. Math. Soc.*, vol. 22, p. 239-246; 1916. J.

Jourdain, Philip E. B. RICHARD DEDEKIND (1833-1916). *Monist.*, XXVI, p. 415-427. July, 1916. 1918

Full account of DEDEKIND's « Stetigkeit und irrationale Zahlen » of 1872 and « Was sind und was sollen die Zahlen? » of 1888 (especially the former) and sketch of the relations of D.'s work to other modern fundamental work in mathematics and logic. J.

Lobachevski, Nicholas. Geometrical Researches on the Theory of Parallels. Translated from the Original by G. B. HALSTED. New Edition, 50 p. Chicago and London, The Open Court Publishing Co., 1914. 1918

This translation of LOBACHEVSKI's « Geometrische Untersuchungen zur Theorie der Parallellinien » (Berlin, 1840) was first published in 1891 (Austin, Texas, U. S. A.), and this edition has a portrait of L., and a supplementary bibliographical note on some recent publications. In the latter it is pointed out that the formulae of the theory of relativity are capable of a very simple interpretation in a L. space. J.

B. — *Physical sciences and technology*

Feldhaus, F M. Die erste Lokomotive Deutschlands [1816] *Geschichtsbl. f. Technik*, t. 3, p. 204-207; 1916. 1918

Harrow, Benjamin. WILLIAM HENRY PERKIN [1838-]. *Scientific Monthly*, t. 9, p. 234-245, New York, 1919. 1918

Kingsbury, John E. The Telephone and Telephone Exchanges. Their invention and development. x+588 p. ill. London, LONGMANS GREEN and Cº, 1915. 1918

Niemann, W. Die Lampe im 19. Jahrhundert. *Geschichtsblätter f. Technik*, t. 3, p. 281-303, 23 Fig. 1916. 1918

Parsons, Charles A. Engineering science before, during and after the war. *Science*, vol. 50, p. 333-338, 355-362, 383-386. New York, 1920. 1918

Address of the President of B. A. A. S., meeting of Bournemouth 1919.

Stein, Robert. Zeitgenössische Kritik über Fourcroys chemische Uebersichtstafeln und deren deutschen Uebersetzungen. *Mit. zur Gesch. d. Med.*, t. 17, p. 85 93, 1918. 1918

Turrière, Emile. Le problème des objectifs de longues-vues dans la dioptrique contemporaine. Exposition des recherches de M. H. HARTING, IV+150 p., 2 pl. Travaux du Bureau d'études d'optique du service géographique de l'Armée, Paris, 1918. 1918

P. 142-149. Pour contribuer à l'histoire du verre d'optique par M. M. VON ROHR (traduit du *Z. f. Instrumentenkunde*, t. 29, p. 50-57, 1909).
G. S.

United States Coast and Geodetic Survey. Centennial celebration, April 5 and 6, 1916, 196 p. ill., portraits, charts. Washington Government Printing Office, 1916.

[Van 't Hoff, Jacobus Henricus] Inaugurazione di un monumento a J. H. VAN 'T HOFF. *Riv. stor. crit. sci*, t. 6, p. 518-519, 1915. 1819

Short note announcing the dedication of a statue of heroic size in Rotterdam, April 17, 1915. It bears the eloquent inscription : « Van 't Hoff, 1852-1911. Physicam chemiae adiunxit. » G. S.

C. — *Natural sciences*

Hertwig, Oscar [1849-]. Dokumente zur Geschichte der Zeugungslehre. Eine historische Studie. 168 S., 25 Abb. Bonn., COHEN, 1918. 1818

Johnsson, J. W. S. ADOLPH HANNOVER [1814-(?)] *Mit zur Gesch. d. Med.*, t. 14, p. 109-111 ; 1915. 1818

A pupil of JOH. MÜLLER ; the first Danish microscopist ; introduced the use of chromic acid for hardening. Bibliography. G. S.

Neuburger, Max. GALLS Verhältnis zum Mesmerismus. *Mit zur Gesch. d. Med.*, t. 15, p. 475-476 ; 1916. 1818

Other notes on Gall's biography by same author, *ibidem*, t. 16, p. 435-436, 1917 ; t. 18, p. 258-259, 1919. See also anonymous note, *Ibidem*, t. 18, p. 159, 1919. G. S.

Roberts, Herbert F. The founders of the art of breeding. III. Pre-Mendelian breeders of the nineteenth century. *The Journal of Heredity*, t. 10, p. 229-239, 257-270. Washington, 1919. 1818

Deals with the investigations of A. F. WIEGMANN, CARL FRIEDRICH, VON GÄRTNER, THOMAS ANDREW KNIGHT, WILL. HERBERT, AUGUSTIN SAGERET, DARWIN, CHARLES NAUDIN, D. A. GODRON, B. VERLOT, MAX WICHURA. — Bibliographical notes. Portrait of KNIGHT (1758-1838). G. S.

Stevens, Neil E. Two Southern botanists and the Civil War. *Scientific Monthly*, t. 9, p. 157-166. New York, 1919. 1818

They are the Rev. M. A. CURTIS and H. W. RAVENEL both distinguished mycologists. Information derived from the unpublished correspondence of Prof. EDW. TUCKERMANN of Amherst, Mass., now the property of his nephew Judge E. T. ESTY of Worcester, Mass. (about 800 letters, 1838-1873, from a great number of botanists). G. S.

Vivaldi, Michelangelo. VINCENZO SETTE, un precursore della batteriologia. *Riv. stor. crit. sci.*, t. 8, p. 207-212, 1917. 1818

Apropos of V. SETTE. Sull' arrossamento di alcune sostanze alimentose osservato nella provincia di Padova l'anno 1819. Venezia 1824. G. S.

D. — *Medical Sciences*

Bright, Richard [Bristol, 1789-1858]. Die Erkrankungen der Nieren (1827-1836). In deutscher Uebersetzung neu hrg. u. eingeleitet von ERICH EBSTEIN. 119 S., 5 T. Leipzig, BARTH, 1916. 1818

Chaplin, Arnold. Rate of mortality in the British Army 100 years ago. *Proceedings R. S. of Med., hist. section*, t. 9, p. 89 ; 1916. 1818

Illustrates the enormous advance made in military hygiene. Thus the peace mortality in West Africa has fallen in 100 years from 362 to 12 per 1,000 and in Jamaica form 185 to 10 per 1,000. C. S.

Clemen, Otto. Zur Geschichte des Mesmerismus. *Mit. zur Gesch. d. Med*, t. 15, p. 382-384, 1916 ; t. 17, p. 169-171, 1918. 1818

Cumston, C. G. L'histoire de la physiologie pathologique des ictères. *Arch. f. Gesch. d. Med.*, t. 8, p. 226 ; 1915. 1818

Dorveaux Paul. Biographie du Dr Lucien Leclerc (1816-1893). *Bull. Soc. franç. hist. méd.*, t. 13, p. 207 ; 1914. 1818

Account of the distinguished historian of Arabian science with bibliography of his writings. C. S.

Neuburger, Max. Zur Geschichte der Auskultation. *Mit. zur Gesch. d. Med.*, t. 18, p. 159-161 ; 1919.

The first to introduce the use of the stethoscope in Vienna was Dr Friedrich Müller, a disciple of Laennec, in 1832. This does not detract anything from Skoda's fame, for Skoda from 1836 on did more than anybody else to develop the auscultation method and in 1846, the Viennese clinic became under his leadership the true home of physical diagnosis. G. S.

Osler, Sir William. The first printed documents relating to modern surgical anaesthesia. *Proc. R. S. of Med., histor. sect.* t. XI, p. 15 ; 1918. 1818

Attempts to do justice to the memory of W. T. G. Morton who first convinced the world of the value of surgical anaesthesia. Suggests the formation of a library on anaesthesia. See *Isis*, III, p. 119. C. S.

Siedler, Paul. Die chemischen Arzneimittel der letzten 113 Jahre, mit Rückblicken auf die Entwicklung der wissenschaftlichen Chemie und Pharmazie für Apotheker, Aerzte und Chemiker. VIII+179 p. Berlin, Borntraeger, 1914. 1818

E. — *Alia*

Dannemann, Friedrich. — Aus Emil du Bois-Reymonds Briefwechsel über die Geschichte der Naturwissenschaften. *Mit. zur Gesch. d. Med.* t. 18, p. 267-274 ; 1919. 1818

Letters to the late Dr G. Berthold of Ronsdorf nr. Düsseldorf. G. S.

Elliot, Hugh. Herbert Spencer (Makers of the nineteenth century). x + 330 p., 1 portr. London, Constable, 1917. 1818

Excellent biography containing much constructive criticism. G. S.

Neuwirth, Joseph. Die K. K. Technische Hochschule in Wien 1815-1915 Gedenkschrift herausg. vom Professorenkollegium, XI + 700 p. Wien, Gerold, 1915. 1818

G. S.

North, S. N. D. (*editor*). A manual of the public benefactions of ANDREW CARNEGIE [-1919]. Compiled and published by the Carnegie Endowment for International Peace, VIII + 322 p., portr. and illustr. Washington, 1919. 1818

Contains brief histories of the various institutions founded by CARNEGIE. The aggregate of his benefactions amounts to about 289 million dollars, but they were all of such constructive nature, that their real value is incomparably greater. G. S.

Paton, Lucy Allen. ELIZABETH CARY AGASSIZ, VIII + 423 p. Boston, HOUGHTON MIFFLIN, 1919. 1818

Mrs. ELIZ. CABOT CARY AGASSIZ was the noble wife of LOUIS AGASSIZ (1807-1873) and the first president of Radcliffe College, the Women's college connected with Harvard. G. S.

Schiff, Julius. Der Naturphilosoph GOTTHILF-HEINRICH SCHUBERT [1780-1860]. *Mit. zur Gesch. d. Med.*, t. 18, p. 17-23, 1919.

S. XX

Shackleton, Sir Ernest [1874-]. South. The Story of SHACKLETON'S Last Expedition. 1914-1917. XXI + 380 p., 88 ill. and diagrams. London, HEINEMANN; New York, MACMILLAN, 1919. 1818

PART II

Historical Classification

The materials which could not be included in the Centurial Classification are classified, if possible, under one of the following headings :

1. Antiquity.
2. Antiquity, classical.
3. Asia (Central, Eastern, Western).
4. Babylonia a. Assyria.
5. Bible (Old Test).
6. Byzantium.
7. China.
8. Egypt.
9. Greece.
10. India.
11. Iran.
12. Islam.
13. Israel.
14. Japan.
15. Middle Ages.
16. Rome.

Items which pertain at the same time to more than one of these headings are preferably put in the Systematic Classification (Part III).

1. — ANTIQUITY

Clay, Albert T. [1866-]. The Empire of the Amorites, 192 p. New Haven, Yale University Press, 1919. 1818

2. — ANTIQUITY, CLASSICAL

Braams, W. Zur Geschichte des Ammenwesens im klassischen Altertum. Jenaer med.-histor. Beitr., Heft 5, 31 p. Jena, 1913.

A collection of references to the practics of wet-nursing drawn from classical writers, both medical and non medical. C. S.

British Museum. A guide to the select Greek and Latin inscriptions exhibited in the Department of Greek and Roman antiquities, 44 p. London, 1917 1818

101 select inscriptions are quoted, sometimes with facsimile reproductions and with all necessary explanations briefly given. The introduction contains a bibliography and a short account of the development of the Greek alphabet. Excellent introduction to epigraphical studies. Price : six pence ! G. S.

Buchheim, E Die geburtshilflichen Operationen und zugehörigen Instrumente des klassischen Altertums. Jenaer mediz.-histor. Beitr., Heft 9. 46 p., 1 pl. Jena, 1916. 1818

An examination of the obstetric teaching of HIPPOCRATES, CELSUS, AETIUS, PAULUS AEGINETA and SORANOS. Contains the best account that has thus far appeared of ancient obstetric instruments and an excellent descriptive plate. C. S.

Diels, Hermann. [1848-]. Antike Technik. Sechs Vorträge, VIII + 140 S., 9 Taf. Leipzig, TEUBNER, 1914. 1818

Kroll, Josef. Die Lehren des HERMES TRISMEGISTOS. Beitr. zur Gesch. d. Phil. des Mittelalters, Bd. 12, XII + 441 p. Münster i. W., ASCHENDORFF, 1914 1818

Lattes, Elia. Per la soluzione dell' enimma etrusco. *Scientia*, t. 26, p. 392-405; 1919. 1818

In defense of the « Italian » thesis, that is, that the Latin and Etruscan were sister races, and their languages of the same kind, with a brief historical sketch at the end. G. S.

Meyer-Steineg, T. Das medizinische System der Methodiker. Eine Vorstudie zu CAELIUS AURELIANUS, de morbis acutis et chronicis. Jenaer med. hist. Beitr., Heft 7-8, 131 p. Jena, 1916. 1818

A very thorough investigation of the remains of the methodic School. Chapters are devoted to ASCLEPIADES of Prusa, THEMISON of Laodikeia, THESSALOS of Tralles and SORANOS of Ephesos, but more than one half of the work is occupied with CAELIUS AURELIANUS whose treatise is the best example now extant of this school. The neglect of CAELIUS' work and the difficulty of his language make this a welcome addition to the history of ancient medicine. C. S.

Stephanides, Michael C. Eine Skizze aus der analytischen Chemie der Alten. *Mit. zur Gesch. d. Med.*, t. 15, p 85-89, 1916. 1818

Summary of a chapter of his work on the History of physical sciences, and especially of chemistry. Athens, 1914 (in Greek). G. S.

3. — ASIA, CENTRAL

Czaplicka, Mary Antoinette. The Turks of Central Asia in history and at the present day. An ethnological inquiry into the Pan-Turanian problem and bibliographical material relating to the early Turks and the present Turks of Central Asia, 242 p. Oxford, Clarendon Press, 1918. 1818

Sudhoff, Karl. Die anatomischen Ganzfiguren in tibetanischen Ueberlieferung. *Archiv f. Gesch. d. Med.*, t. 8, p. 143, 1914. 1818

Describes two anatomical figures of modern Tibetan origin which present certain affinities to the mediaeval five figure series. C. S.

4. — BABYLONIA AND ASSYRIA

Dennefeld, Ludwig [1883-]. Babylonisch-assyrische Geburtsomina, zugleich ein Beitrag zur Geschichte der Medizin. VI + 232 p. (Assyriologische Bibliothek, Bd. 22). Leipzig, HINRICHS, 1914. 1918

Hrozny, Friedrich. Das Getreide im alten Babylonien. Ein Beitrag zur Kultur- und Wirtschaftsgeschichte des alten Orients. 1. Teil. Mit einem botanischen Beitrag von FRANZ V. FRIMMEL: Ueber einige antike Samen aus dem Orient. *Sitzungsber. d. K. Ak. d. Wiss., Phil. hist. Kl.*, Bd. 173, 216 S., 2 T. Wien, 1914. 1918

Jastrow, Morris. The medicine of the Babylonians and Assyrians. *Proc. R. S. of Med., hist. sec.*, t. 7, p. 109-176, 1914. 1918

Valuable summary of our knowledge of the subject with the translation of several texts. A full explanation (with fig.) is given of the process of hepatoscopy and an attempt is made to bring the form of the clay model of the sheeps liver used for divination in line with the anatomical findings.
C. S.

Keiser, Clarence Elwood. Patesis of the Ur dynasty. 34 p. (Yale Oriental series, researches, vol. 4, 2.) New Haven. Yale Univ. Press, 1919. 1918

Meissner, Bruno. Das Antimongebirge. *Orientalische Literaturzeitung*, t. 17, Sp. 52-55, 1914. 1918

Pancritius, Marie. Babylonische Tierdarstellungen. *Orient. Literaturz.*, t. 17, Sp. 160-163, 1914. 1918

Weidner, Ernst F. Sumerische Apotropaia. *Orient. Literaturz.*, t. 17, Sp. 304-308, 4 Abb., 1914. 1918

5. — BIBLE

Kopciowski, A. La lebbra nella Bibbia. *Riv. Stor. crit. Sc.*, t. 7, p. 137-147, 1916. 1918

6. — BYZANTIUM

Diehl, Charles. Byzance. Grandeur et Décadence, 343 p. Bibliothèque de Philosophie scientifique. Paris, FLAMMARION, 1919. 1918

7. — CHINA

Ferguson, John Calvin [1866-]. Outlines of Chinese art. The SCAMMON lectures for 1918, Chicago Art Institute, XI + 263 p., ill. Chicago, University Press, 1919. 1918

Giles, Herbert A. An introduction to the history of Chinese pictorial art. 2d. ed., revised and enlarged, XII + 219 p., ill. London, QUARITCH, 1918. 1918

Giles, Herbert A. Spuren der Luftfahrt im alten China. Übersetzt und mit Erläut. vers. v. A. Schück [u. F. M. Feldhaus]. *Geschichtsbl. f. Technik*, t. 4, p. 79-83, 1917. 1918

Translated from Adversaria Sinica, Shanghai, 1910.

Hopkins, L. C. L'écriture dans l'ancienne Chine, *Scientia*, t. 27, p. 19-40, 1920. 1918

Schück, A. Zur Entwicklung der Einteilungen der chinesischen Schiffs- und der « Gaukler »-Bussole. *Mit. zur Gesch. d. Med.*, t. 16, p. 7-10, 1917. 1918

Vincent, Eugène [1843-]. La médecine en Chine au XX^e^ siècle. La vieille médecine des Chinois, les climats de la Chine, l'hygiène en Chine et l'hygiène internationale. 316 p. ill. Paris, STEINHEIL, 1915. 1918

Werner, Edward Theod. Chalmers [1864-]. China of the Chinese, XVI + 309 p., 14 pl., 1 map. London, PITMAN, 1919. 1918

W. is the author of the section devoted to China in SPENCER'S « Descriptive Sociology »; he has lived 30 years in China. The plan is sociological, chapters being successively devoted to political history, domestic institutions, political inst., ecclesiast. inst., sentiments, ideas, languages, products of Chinese civil. G. S.

8. — EGYPT

Lythgoe, Albert M. The Treasure of Lahun. *Bull. Metropolitan Museum of Art*, Dec., Part II, 28 p., 25 ill. New York, 1919. 1918

Description of the jewelry of the Princess SAT-HATHOR-IUNUT, in all probability the daughter of king SENUSERT II of the XII^th^ dyn., who reigned from 1906 to 1887 B. C. and near whose pyramid, at Lahun, she was buried. G. S.

Netolitzky, F. Trichodesma africanum, die älteste nachgewiesene Heilpflanze *Arch. f. Gesch. d. Med.*, t. XI, p. 256, 1919. 1918

N. has examined dessicated Egyptian bodies of the Nagada period (about 5000 B. C.) and has detected in their intestines remains of Trichoderma afric., a plant allied to the Cynoglossum offic. of the modern Western pharmacopoeias. This plant, he considers, was taken as a drug. C. S.

Regnault, Félix. Les nains dans l'art égyptien, *Bull. Soc. franç. hist. méd.*, t. 13, p. 137, 1914. 1918

Gives several fig. of dwarfs from the monuments and seeks to show that they are the images of myxœdematous subjects. C. S.

Reinhard, F. Gynäkologie und Geburtshilfe der altägyptischen Papyri. *Arch. f. Gesch. d. Med.*, t. 9, p. 315, 1916; t. 10, p. 124, 1917. 1918

Contains extracts referring to midwifery and gynaecology from all the Eg. medical papyri. These are (1) Pap. EBERS, XVI^th^-XIV^th^ cent.; (2) the greater Berlin pap. (BRUGSCH) of same period; (3) the lesser Berlin pap. of same period; (4) the HEARST pap. which is of a much later date and (5) the London pap. of the 18th. or 19th. dyn. (*i. e.* XIII^th^ cent.). The material consists of an inextricable mixture of magical and rational therapy. C. S.

Wreszinski, Walter [1880-]. Atlas zur altägyptischen Kulturgeschichte. Lief. 1-5, gr. in-4°. Leipzig, HINRICHS, 1914. 1918

There will be 20 fasc.; in progress.

9. — GREECE

Buckler, W. H. and **Caton, Richard.** A group of medical and surgical instruments found at Colophon. *Proc. R. S. of med. hist. section*, t. 7, p. 235, 1914. 1818

Description of a new and unusually complete find of bronze instruments. C. S.

Caton, Richard. Health temples in ancient Greece and the work carried on in them. *Proc. R. S. of medic. hist. sect.*, t. 7, p. 57, 1913. 1818

Contains some of the writers own restorations and his personal impressions of the sites. C. S.

Pseudo-Galen. In HIPPOCRATIS de septimanis commentarium ab HUNAINO q. f. arabice versum ex codice monacensi primum edidit et germanice vertit GOTTHELF BERGSTRAESSER. (*Corpus medicorum graecorum*, XI, 2, 1). Large in-8°. XXIV + 203 p. Leipzig, TEUBNER, 1914. 1818

Just when the fund of Greek medical mss. seemed almost exhausted, new light has been thrown on the Greek originals by the publication of translations of Arabic versions of lost texts. In 1906 we had the important text of the seven missing anatomical books of GALEN with a transl. by SIMON and this has now been followed by the work before us. This work represents that debased form of Greek science that laid great stress on analogy and made it a substitute for experience. Especially it attempts to force the description of the phenomena of both lesser and greater as well as outer and inner world into its scheme of sevens. C. S.

Whittaker, Thomas [1856-]. The Neo Platonists. A study in the history of Hellenism. 2d ed., with a supplement on the commentaries of PROCLUS. XVI + 318 p. Cambridge University Press, 1918. 1818

10. — INDIA

Kaye, G. R. Ancient Hindu spherical astronomy. *Journal and Proc., Asiatic Soc. of Bengal*, t. 15, p. 153-189, 1919. 1818

Comparative summary in modern mathematical language of the classical Sanscrit astronomical texts, to wit the Āryabhatīya (A. D. 498), the Pañchasiddhāntikā (ca. A. D. 550), the Brāhmasphuṭasiddhānta (A. D. 628) and the later Sūrya Siddhānta (ca. A. D. 1000). — At the end of the paper, ten astron. and math. tables permit of a very quick survey and comparison. G. S.

11. — IRAN

Jayne, Walter A. The medical gods of ancient Iran. *Annals of medical history*, II, p. 8-13. New York, 1919. 1818

12. — ISLAM

Horten, Max [1874-]. Einführung in die höhere Geisteskultur des Islam. Gemeinverständlich dargestellt. XV + 112 p. Bonn, COHEN, 1914. 1818

Islam, Der. Zeitschrift für Geschichte und Kultur des Islamischen Orients. Herausgegeben von C. H. BECKER. Strassburg, Karl J. TRÜBNER, 1918

The V th vol., 1914 is analyzed in the 8th. bibliogr. of *Isis*. One of the features of this excellent periodical is its very elaborate « Kritische Bibliogr. », see p. 249-334, 394-423, in all 1205 items. Section IV is entitled « Naturwiss., inkl. Mathematik u. Medizin. » It is a pity however that the relatively few papers relating to ancient Arabic science are lost amidst a heap of papers dealing with modern conditions (for ex. Oriental diseases, modern practice of medic.). The other sections are open to the same criticism. Some chronological sub-classification should be introduced. G. S.

Lippmann, Edmund O. von. Einige Mitteilungen über die mittelalterliche Zuckerindustrie. (Vortrag gehalten am 6. Nov. 1916). *Die Deutsche Zuckerindustrie*. Berlin, 1917. 1918

Based on extracts from the encyclopaedist NUWAIRÎ (d. 1332) describing the fabrication of sugar ab. 1325 in Egypt and Syria; the agricultural writer IBN AL AWÂM (fl. second half of XII), describing fabrication of sugar in Spain, and NABARÂWÎ (XIIth c.) speaking of sugar falsifications : clarification of molasses by means of vinegar of lead, and showing how to detect this. G. S.

Meyerhof, Max. Der Bazar der Drogen und Wohlgerüche in Kairo. *Arch. f. Wirtschaftsforschung im Orient*, p. 1-40, 185-218. Weimar, 1918. 1918

Moll, F. Zur Geschichte der Technik in der islamitischen Literatur, *Geschichtsbl. f. Technik*, t. 4, p. 32-34; 1917. 1918

Showing how the technical development of Mohammedan countries was impeded by religious fanaticism. G. S.

Muir, Sir William. The Caliphate, Its rise, decline and fall. From original sources. A new and revised ed. by T. H. WEIR, XX + 663 p., 4 maps. Edinburgh, JOHN GRANT, 1915. 1918

First ed. 1883, 2^{d} 1891, 3^{d} 1899. Chiefly based upon the annals of IBN ALL ATHÎR (XIIIth c.), which is an epitome and continuation of the work of TABARI (d. 923), which itself consist almost wholly from citations from older sources, — also on WEIL's Geschichte der Chalifen, 1846-1862. Many of WELLHAUSEN's observations have been incorporated in the present edition, which includes also new documents on the conquest of Syria and Egypt. The history of science and letters is almost entirely neglected. The first ed. was entitled « Annals of the Early Caliphate » and the following abridged ed. have kept substantially the same form, the narration proceding year by year from 11 to 926 A. H. (632 to 1520 A. D.). The account of the first five and of the first hundred years take respectively more than 100 and 385 pages ! G. S.

Ruska, Julius. CASSIANUS BASSUS SCHOLASTICUS und die arabischen Versionen der griechischen Landwirtschaft. *Islam*, t. 5, p. 174-179; 1914. 1918

Schoy, C. Ueber einige dem Arabischen entlehnte Benennungen in den exakten Wissenschaften. *Mit. zur Gesch. d. Med.*, t. 16, p. 125-130; 1917. 1918

Zenit und Azimut; Nadîr; Al^{e} iḍâde; Theodolith; Almuqanṭarât, Al-ruchâma; Basîṭa; Qibla; Miqjâs; Muwaqqit; Mu'aḍḍin; Mukḥula; Algebra; Ziffer; X. G. S.

Wensinck, A. J. Die Entstehung der muslimischen Reinheitsgesetz gebung. *Islam*, t. 5, p. 62-80. 1914. 1918

Das muslimische Reinheitsgesetz hängt mit dem jüdischen zusammen. In welchem Grade aber ersteres von letzerem abhängig ist, ist noch nicht untersucht worden. Eine derartige Untersuchung ist wichtig weil sie dazu beiträgt, den jüdischen Einfluss auf das werdende islamische System bis in die Details blosszulegen. Im wesentlichen ist das muslimische Reinheitsgesetz eine Erleichterung des jüdischen. *Nadjis* u. *Mutanadjdjis*. Das Waschwasser. Das Bad (Ghusl). Die Waschung (Wuḍû'). G. S.

Wiedemann, Eilhard. Ueber Erfinder nach arabischen Angaben. *Geschichtsbl. f. Technik*, t. 3, p. 193 195; 1916. 1918

Wiedemann, Eilhard. Ueber Schiffe deren Bretter nicht zusammengenagelt sind. *Geschichtsbl. f. Technik*, t. 3, p. 280-281; 1916. 1918

Short notes extracted from AL GÂḤIẒ (d. 869), IBN GUBAIR (ca. 1200), the so-called lapidary of ARISTOTLE; TIFÛSHÎ and ḤARÎRÎ. G. S.

Wiedemann, Eilhard. Zur Kenntnis der Naturwissenschaften in der muslimischen Welt. *Geschichtbl. f. Technik*, t. 5, p. 109-112; 1918. 1818

Very brief summary of Moham. achievements in science. G. S.

Wiedemann, Eilhard. Ueber Schiffsmühlen in der muslimischen Welt. *Geschichtsbl. f. Technik*, t. 4, p. 25-26; 1917. 1818

Short notes about shipmills (*'Araba*) extracted from the BENÛ MÛSÂ (ca. 850); AL CHWÂRIZMÎ; IBN AL ATÎR (930); IBN ḤAUQAL (ca. 1000); QAZWÎNÎ (1203-1283); JÂQÛT (1179-1229); CHAFÂGÎ. G. S.

Wiedemann, Eilhard und **Hauser, Fritz.** Ueber die Uhren im Bereich der islamischen Kultur. *Nova Acta, Abh. d. Kais Leop. Carol. Deutchen Akademie der Naturforschern*, Bd. C, 272 S. in-4°, 136 Abb. Halle, 1915. 1818

Würschmidt, J. Die Bestimmung der krummen Stunden der Deklination und der Gebetszeiten mittels des Astrolabs. *Mit. zur Gesch. d. Med.*, t. 18. p. 183-190; 1919. 1818

Based on a Turkish work of GARI ACHMED MUCHTAR Pascha « Ryaz almuchtar », Cairo 1303 A. H. (= 1887 A. D.) which is essentially similar to a part of GREGOR REISCH's « Margarita philosophica » (Bâle ca. 1503), Appendix to Book VII, « Tractatus de compositione instrumentorum astronomicorum ». G. S.

13. — ISRAEL

(Cfr. also *Bible*)

Ratner. Eine Bemerkung zur talmudischen Anatomie. *Mit. zur Gesch. d. Med.*, t. 14, p. 292-293; 1915. 1918

Attempt to explain the statement (Tract. Chulin 45*b*) that there are three pipes (Koneh), one leading to the Heart, the second to the Lungs and the third to the Liver. G. S.

15. — MIDDLE AGES

Enlart, Camille [1862-], Manuel d'archéologie française depuis les temps mérovingiens jusqu'à la Renaissance. Vol. I. L'achitecture religieuse, 1902; Vol. II. L'architecture civile et militaire, 1904; Volume III. Le costume, 1916. Paris, AUG. PICARD. 1918

Ganzenmüller, Wilhelm. Das Naturgefühl im Mittelalter. (Beitr. zur Kulturgesch. des Mittelalters u. der Renaissance, Bd. 18) 304 S. Leipzig, TEUBNER, 1914. 1818

Haberling, W. Die Verwundetenfürsorge in den Heldenliedern des Mittelalters. Jenaer med.-histor. Beitr., Heft 10. 51 S., 13 Abb. Jena, 1917. 1818

A useful summary at second hand of surgical procedure as recounted in heroic mediaeval literature. The textfigures are interesting but the practice of giving figs. in scientific publications without documenting them adequately as to their source, etc. is to be altogether deprecated. C. S.

Koehne, Carl. Zur Art der Verbreitung technischer Fortschritte im früheren Mittelalter. *Geschichtsbl. f. Technik*, t. 3, p. 275-280; 1916. 1818

Lippmann, Edmund O. von. Verwendungen des Petroleums im frühen Mittelalter. *Chemiker Zeitung*, p. 473. Cöthen, 1914. 1818

Various short notes on the uses of petroleum and naphta (military and naval, Grecian fire, protection against pirates at sea, medical, lighting) chiefly from Arabic sources. G. S.

Lippmann, Edmund O. van. Chemisches und Technologisches aus kunstgeschichtlichen Quellenschriften. I. HERACLIUS. *Chemiker Zeitung*, p. 3, 26, 48. Cöthen; 1916. Reprint, 18 p. 1818

The mediaeval compilation on the colours and arts of the Romans attributed to one HERACLIUS (cfr. ILG. *Quellenschr. f. Kunstgeschichte*, Bd. 4, Wien 1873) in made up of 3 parts. Parts 1 and 2 are written in blank hexameters by a Roman writer, they date of the xth c.; part 3 was written in France in Latin prose in the XIIth or the beg. of the XIIIth c. L. analyzes the chemical and technological contents of the whole work. G. S.

Mittelalterliche Bibliotekskataloge Deutschlands und der Schweiz, hrg. von der König. Bayerischen Akademie der Wissenschaften in München. I Band. Die Bistümer Konstanz und Chur v. PAUL LEHMANN. In-f°, XX+600 S., 1 K. München, 1918. 1818

Mittelalterliche Bibliothekskataloge Oesterreichs hrg. von der Kaiserl. Akad. der Wissenschaften in Wien. I. Band. Niederösterreich v. THEOD. GOTTLEIB. In-f°, XVI+616 S., 2 K. Wien, 1915. 1818

The examination of ancient library catalogues is a comparatively new means of investigation which has already thrown much new light on mediaeval thought. The survival of Mss is something of an accident, those alone being copied and preserved which each age thinks the most valuable among the survivors of a previous age. But if we turn to the ancient catalogues we are able to form an estimate of the books that were cherished at any particular period. — These two portly volumes are an important contribution to this new line of research. Of especial interest is the ancient library of St. Gall with its series of IXth cent. catalogues containing many medical and scientific items. The Austrian volume is unfortunately not provided with an index. C. S.

Seligmann, S. Die Siebenschläfer-Amulett. mit einem Beitrage von ERICH GRAEFE. *Islam*, t. 5, p. 370-388. Strassburg, 1914. 1818

The legend of the Seven Sleepers of Ephesus — a Syriac legend first recorded by GREGORY of Tours — was widely spread in the mediaeval

world. Many Western texts are here quoted but the essay is chiefly devoted to the Mohammedan variants. Arabic amulets referring to this superstition are reproduced (two show also magic squares) and their text translated. G. S.

Sudhoff, Karl. Ein neuer Text der « Initia medicinae ». *Mit. zur. Gesch. d. Med.*, t. 15, p. 281-287. 1916. 1818

Copy of an old text — already known to ISIDORE of Seville — written and annotated by Dr SIGMUND GOTZKIRCHER of Munich, ab. the middle of XV, one of many texts collected by him, now in the Berlin Kgl. Bibliothek (Cod. lat. fol. 88) : « incipit liber de invencione artis medicine quomodo fuit inventa ars medicine in tempore Noe ». S. reproduces this text, also some of GOTZKIRCHER'S notes and discusses its signification. G. S.

Sudhoff, Karl. Szenen aus der Sprechstunde und bei Krankenbesuchen des Arztes in mittelalterlichen Handschrift. *Archiv f. Gesch. d. Med.*, t. 9; 1916. 1818

16. — ROME

Barduzzi, D. La responsabilità dei medici nell'antica Roma. *Riv. Stor. Crit. Sci.* t. 8, p. 237-241; 1917. 1818

Barnes, H. On Roman medicine and medical inscriptions found in Britain. *Proc. R. S. of Med., Hist. Sect.*, t. 7, p. 71; 1914. 1818

A collection of data from a widespread and somewhat inaccessible literature. Figures. C. S.

Helmreich, Georg. Zum sogenannten ESCULAPIUS. *Mit. zur Gesch. d. Med.* t. 18, p. 24-32, 1919. 1818

First ed., Strassburg 1533; 2nd, 1544, in JOH. SCOTT, Experimentarius medicinae, no other. His work is intimately connected with that of CAELIUS AURELIANUS and is of importance for the study of the Methodic School. His language, although it contains many mediaeval elements, is substantially anterior to the VIth cent. His Mss have not yet been critically studied but it is possible to make a first cleaning of the text by reference with GARIOPONTUS who incorporated the whole of ASCULAPIUS in his own compilation. The object of H.'s paper is to make this preliminary comparison. G. S.

Sudhoff, Karl. Ein Stelzbein aus altklassischer Zeit Italiens. *Mit. zur Gesch. d. Med.*, t. 15, p. 76-77, 1916; t. 16, p. 291-293, 1917. 1818

About a wooden leg with bronze and iron fixtures discovered in a tomb near Capua, Campania and dating of ca. 300 B. C. G S.

PART III

Systematic Classification

The materials which could not be included in the two previous classifications — Centurial and Historical — are classified under the following headings. This third classification is exhaustive because, if any item could not be placed under the 35 first headings, it would be put under the 36th and last one : *Alia*.

1. Anatomy.
2. Anthropology.
3. Archaelogy, museums and collections.
4. Art. Art and science. Iconography.
5. Arts and Crafts.
6. Astronomy, geodesy, meteorology and terrestrial physics.
7. Bibliography and libraries.
8. Biology.
9. Botany.
10. Chemistry, Physicochemistry.
11. Economics (ec. doctrines, commerce, transportation, communications).
12. Education.
13. Ethnology. Primitive and popular science.
14. Geography.
15. Geology, mineralogy, palaeontology. Mining.
16. History of civilization.
17. Language and literature.
18. Logic and theory of knowledge.
19. Mathematics.
20. Mechanics.
21. Medicine :
    A. Hist. and organization.
    B. Epidemiology.
22. Morals, Moral organ. of Society.
23. Pharmacy.
24. Philosophy. Science and Phil. History of Philosophy.
25. Physics.
26. Physiology.
27. Prehistory.
28. Psychology.
29. Religion.
30. Science :
    A. Bibliography.
    B. History.
    C. Organization.
    D. Philosophy.
31. Sociology, jurisprudence and positive polity.
32. Statistics.
33. Superstition and Occultism.
34. Technology.
35. Zoology.
36. Alia.

1. — ANATOMY (human and comparative)

Corner, George W. Anatomists in search of the Soul. *Annals of medical History*, t. 2, p. 1-7. New York ; 1919. 1818

Ebstein, Erich. Zur Ethnologie und Synonymik des Albinos. *Mit. zur Gesch. d. Med.*, t. 14, p. 284, 295 , 1915. 1819

3. — ARCHÆOLOGY (museums and collections)

Feldhaus, Franz M. Schrauben-Verschlüsse an Schmuckstücken des Altertums. *Geschichtsbl. f. Technik*, t. 4, 51-58, 18 Abb., 1917. 1818

Ward, William Hayes. The seal cylinders of Western Asia. Second edition. Quarto, XXIX+428 p., 1,500 fig. Washington, CARNEGIE Institution, 1919. 1818

Photographic reprint of the first ed , 1910. Collection as complete as possible, of the cylinders of W. Asia, from Persia to Palestine and Cyprus, classified by subjects and secondarily by countries G. S.

6. — ASTRONOMY, GEODESY, METEOROLOGY AND TERRESTRIAL PHYSICS

Auric, A. Sur la réforme grégorienne du calendrier. *Revue scientifique*, p. 362-366. Paris, 1919. 1818

Feldhaus, Franz M. Gläserlose Fernrohre im Mittelalter, *Geschichtsbl. f. Technik*, t. 5, p. 86-89, 3 Abb,; 1918. 1818

8. — BIOLOGY

Heller, Hans. Bemerkungen zu einer geschichtlichen Entwicklung der vor-Darwinischen Biologie. *Mit zur Gesch. d. Med.*, t. 18, p. 161-165; 1919. 1818

A propos of RADL's historical introd. to CHUN-JOHANNSEN. Allgemeine Biologie. Leipzig, TEUBNER, 1915. G. S.

Schmid, Bastian und **Thesing, C.** (*editors*). Biologen-Kalender. 1. Jahrgang. Leipzig, TEUBNER, 1914. 1818

Morgan, Thomas Hunt. The physical basis of Heredity. 300 p., 109 ill. (Monographs on experim. biology). Philadelphia, LIPPINCOTT, 1919. 1818

Popenoe, Paul and **Johnson, Roswell Hill.** Applied Eugenics, XII + 459 p. New York, MACMILLAN, 1918. 1818

Richet, Charles. La sélection humaine. (Biblioth. scientif. internationale) 262 p. Paris, ALCAN, 1919. 1818

9. — BOTANY

(Agronomy, Phytopathology, Palaeobotany)

Brooks, Eugene Clyde [1871-]. The story of corn and the westward migration, IX+308 p. Chicago, RAND MC NALLY & Co., 1916. 1818

Green, Joseph Reynolds [1848-1914]. A history of botany in the United Kingdom from the earliest times to the end of the XIXth century, XII + 648 p. London, Dent, 1914. 1818

Science is and must be essentially international. It is thus not easy to confine its history within territorial, national or linguistic limits and such attempts usually end in mere antiquarianism. In the particular case before us however, England has played so important a part in the early history of botany that the story can be made a logical and fairly consecutive one. For the later period the method breaks down and the book is not a history but a mere record of events. The story is well and pleasantly told and the first part of it is considerable value. C. S.

Laufer, Berthold. Malabathron, 49 p., 12 fig. Extrait du *Journal asiatique*, Paris, 1918. 1818

Etude sur le μαλάβαθρον ou φύλλον Ἰνδικόν qu'il est impossible d'identifier à l'aide des témoignages des auteurs classiques ou sanscrits. Cette plante n'est pas mentionnée par THÉOPHRASTE; les plus anciens témoignages y relatifs sont ceux de PLINE, de DIOSCORIDE et du Périple. L'étude de L. est

consacrée surtout aux documents chinois. Le malabathron tamālapattra, des Hindous, ho hiang des Chinois, serait une sorte de menthe ou plus précisément de patchouli (*Pogostemon*) originaire de Silhet (Assam), Penang ou de la péninsule malaise. Une fig. extraite de CLUSIUS, 1567 et onze autres tirées d'ouvrages chinois permettront de préciser cette identification. G. S.

Sirks, M. J. Altes und Neues über die Bestäubung und Befruchtung der höheren Pflanzen. *Naturwissenschaftliche Wochenschrift*, p. 729-740. Iena, 1915. 1918

Sirks, M. J. Geschichtliches über Pelorienblüten. *Naturw. Wochenschrift*, t. 14, p. 228-231. Iena, 1915. 1918

Spoehr, H. A. The development of conceptions of photosynthesis since INGEN-HOUSZ. *Scientific monthly*, t. 9, p. 32-46, New York, 1919. 1918

True, Rodney H. Notes on the early history of the Pecan in America. *Report of the Smithsonian Institution for 1917*, p. 435-448. Washington, 1919. 1918

10. — CHEMISTRY. PHYSICOCHEMISTRY

Klinckowstroem, Carl von. Ein Beitrag zur Geschichte der chemischen Feuerzeuge. *Geschichtsbl. f. Technik*, t. 2, p. 226-233, 1915. 1918

Moureu, Charles. LAVOISIER et ses continuateurs. *Revue scientifique*, p. 705-721. Paris, 1919. 1918

« La chimie est une science française »..., « il n'apparaît pas qu'après un demi-siècle d'admirables progrès ce jugement ait perdu de sa force et de sa vérité ». Il ne faut pas s'attendre à ce qu'un résumé historique qui débute ainsi soit impartial. Il est intéressant toutefois de remarquer que des quelque 111 savants cités dans ce plaidoyer, 40 sont Français, 28 Allemands et 19 Anglais. G. S.

Rhousopoulos, O. A. Zur Geschichte der Quecksilberverbindungen. *Mit. zur Gesch. d. Med.*, t. 14, p. 406, 1915.

Clarke, Frank Wigglesworth [1847-]. The Data of Geochemistry. 3d ed., 822 p. (Bull. 616, U. S. Geological survey publ.) Washington, Government printing office, 1916. 1918

First ed. 1908 (716 p.), 2d ed. 1911. The 3d ed. is revised and enlarged.

Pope, Sir William. Sur la dissymétrie moléculaire. *Revue scientifique*, p. 33-42. Paris, 1920. 1918

11. — ECONOMICS

(Economic doctrines and history, Commerce, Transportation, Communications)

D'Avenel, Georges. L'évolution des moyens de transport. Voyageurs, lettres, marchandises. (Bibl. de philosophie scientifique) 266 p. Paris, FLAMMARION, 1919. 1918

Library of Congress. List of references on Shipping and Shipbuilding compiled under the direction of HERMANN B. MEYER. 304 p., 2206 items. Washington, Government printing office, 1919. 1818

History of Shipping, p. 5-16; History of Shipbuilding, p. 189-197. Author and subject indexes, p. 273-303. The subject index refers to papers relative to the history of iron and steel ships, sailing ships, steamships, warships, woodenships. G. S.

Library of Congress. Select list of references on Economic Reconstruction. Including reports of the British ministry of reconstruction, 47 p. Washington, Government printing office, 1919. 1818

Mac Gill, Caroline E. (*editor*). History of Transportation in the United States before 1860. Prepared under the direction of BALTHASAR HENRY MEYER, XII + 678 p., 5 maps. Washington, CARNEGIE Institution, 1917. 1818

12. — EDUCATION

(Methods, Colleges, Universities)

Bronson, Walter Cochrane [1862-]. The History of BROWN University, 1764-1914, IX + 547 p., ill. The University, Providence, Rhode Island, 1916. 1818

Favaro, Antonio. La Università di Padova ed il suo settimo centenario (1222-1922). *Archivio di Storia d. Scienza*, I, p. 151-152, 1920. 1818

Program of work it is proposed to undertake to commemorate this VII[th] centenary. G. S.

Universitatum et eminentium scholarum index generalis. Annuaire général des Universités publié sous la direction de R. DE MONTESSUS DE BALLORE, 768 p. Paris, GAUTHIER-VILLARS, 1919. 1818

13. — ETHNOLOGY

(Primitive and popular science)

Baas, K. Uranfänge und Frühgeschichte der Krankenpflege. *Arch. f. Gesch. d. Med.*, t. 8, p. 146; 1914. 1818

Traces nursing practice back to animal habits and forwards as far as the Christian era. Not adequately documented. C. S.

Crawfurd, Raymond. Legends and lore of the genesis of the healing art. *Proc. R. S. of med., hist. section*, t. 10, p. 1; 1917. 1818

Deals with medicine in the earliest and crudest states and lays some stress on healing acts among animals. C. S.

Denmore, Frances. The Sun dance of the Teton Sioux. *Nature*, p. 437-440, ill. London, Jan. 1, 1920. 1818

Henderson, Junius [1865-] and **Harrington, John Peabody.** Ethnozoology of the Tewa Indians, X+76 p. Bureau of American Ethnology, Bull. 56. Washington, Government printing office, 1914. 1818

Laufer, Berthold. The vigesimal and decimal systems in the Ainu numerals. With some remarks on Ainu phonology. *Journal of the American Oriental Soc.*, vol. 37, p. 192-208; 1917. 1813

The words for 1 to 4, 10, 20 are simple and unalyzable stems; the word for 5 was derived from the word meaning hand. From 11 to 19 the numbers follow the decimal system, while from 20 onwards a vigesimal system is carried through with clear consistency. Similar conditions are found in American languages. — The greatest part of the paper is devoted to phonological considerations which may eventually help us to disentangle, if it ever be possible, the history of early migrations into Japan. L. is very skeptical on this point : « Ainu is an isolated language at present, its congeners if they ever existed being extinct long ago. » G. S.

Mackenzie, D. Folk cures by constriction and rings. *Proc. R. S. of med., hist. sect.*, t. 9, p. 143; 1916. 1814

Describes the process by which the spirit of disease is squeezed or pushed out of the affected parts. C. S.

Marett, R. R. The primitive medicine man. *Proc. R. S. of med., hist. sect.*, t. 11, p. 47; 1918. 1815

Distinguishes two separate sources of medicine : (*a*) the leechcraft of the plain man, and *b*) the professional activity of the medicine man. C. S.

Niemann, W. Ueber die älteste Art der Feuererzeugung. *Geschichtsbl. f. Technik*, t. 2, p. 216-224; 1915. 1815

Theal, George McCall. Ethnography and condition of South Africa before A. D. 1505... Second ed. in the present form, illustr., enl. and improved 466 p. London, Allen, 1919. 1818

14. — GEOGRAPHY

Almagia, Roberto. La Geografia, x+109 p. (Guide ICS, Profili bibliografici de L'Italia che scrive). Roma, Istituto per la propaganda della cultura italiana, 1919. 1819

The first of a series of little books to be devoted to bibliographical sketches of the Italian contributions to science and civilization. The bibliography proper is preceded by an introductory text (67 p.), a sort of short synthesis of Italian efforts in the field of geography. — The bibliogr. itself is a little disappointing because there is no systematic classification according to subject but simply an author list. It is a select list but not a synthetic bibliogr. It is true that the introductory text gives one a key to the author's list, but that is insufficient. No tables and no index? G. S.

Wieder, Frederik Caspar. Nederlandsche historisch-geographische Documenten in Spanje... met een inleiding tot de studie der Oudnederlandsche Cartographie, viii + 348 p., maps. Leiden, Brill. 1915. 1815

Wieder, Frederik Caspar. The Dutch discovery and mapping of Spitsbergen (1596-1829), edited by order of the Netherland minister of foreign affairs, 124 p., 45 pl. and maps. Amsterdam, Netherland ministry of foreign affairs and Royal Dutch geographic Society, 1919. 1816

15. — GEOLOGY. MINERALOGY. PALAEONTOLOGY. MINING

(for palaeobotany and palaeozoology, see respectiv. botany and zoology)

Branner, John Casper. Outlines of the Geology of Brazil to accompany the geologic map of Brazil (1 : 5.000.000). *Bull. Geol. Soc. of Amer.*, vol. 30, p. 189-338, 3 pl. and col. map; 1919. 1818

Accumulation of data begun by BR. in 1874. Federal geol. survey of Brazil exists only since 1907. P. 199-202, History of the geological maps of Brazil : 1842 A. D'ORBIGNY, etc. G. S.

Merrill, George P. The composition and structure of meteorites compared with that of terrestrial rocks. *Report of the Smithsonian Institution of 1917*, p. 175-188, 9 pl. Washington, 1919. 1818

Vaughan, Thomas Wayland. Corals and the formation of coral reefs. *Report of the Smithsonian Institution for 1917*, p. 189-238, 37 pl. Washingtgn, 1919. 1818

16. — HISTORY OF CIVILIZATION

General history. Historical methods. Biography and Chronology

Haberling, W. Das Dirnenwesen in den Heeren der Vergangenheit und seine Bekämpfung, IV + 103 p., 8 Abb., 1 Doppelt. *Zeitschrift f. Bekämpfung der Geschlechtskrankheiten*, t. 15, 1914 (*passim*). Leipzig, BARTH, 1914. 1814

Huntington, Ellsworth [1876-]. World Power and Evolution, 287 p., 30 fig. New Haven, Yale University Press, 1919. 1818

Revue de Synthèse Historique, dirigée par HENRI BERR. Tome XXIX consacré aux Etats-Unis, 303 p. Paris, LÉOPOLD CERF, 1919. 1815

Vol. 28 of the R. S. H. had appeared in 1914; after an interruption of more than 5 years, vol. 29 is heartily welcome. This new volume is entirely devoted to the U.S., but for an introductory editorial. Essays by CH. BASTIDE, C. CESTRE, J. GRÉBER, CH. M. GARNIER, A. VIALLATE, E. LEROUX, G. CHINARD, R. PRUVOST, E. BURNET, J. REYNIER... G. S.

Whitbeck, R. H. Our iron-clad civilization. *Scientific Monthly*, t. 9, p. 125-130. New York, 1919. 1818

Shows to what extent modern Western civilization is dominated and molded by iron and coal. Simple sketch. G. S.

18. — LOGIC AND THEORY OF KNOWLEDGE

Russell, Bertrand. On the Experience of Time. *Monist*, XXV, p. 212-233. April, 1915. 1818

This article is concerned with all those immediate experiences upon which our knowledge of time is based. The article is of great interest in connexion with RUSSELL's application of mathematical logic to physics, and it contains a definition of an *instant* as a class which is identical with all the terms that are simultaneous with every member of itself. J.

19 — MATHEMATICS

Bortolotti, Ettore. Italiani scopritori e promotori di teorie algebriche, 102 p., *Ann. d. R. Univ. d. Modena*, Anno 1918-1919. Modena, FERRAGUTI, 1919. 1818

Cajori, Florian. The history of ZENO's arguments on motion. Phases in the development of the theory of limits. *The Amer. mathem. monthly*, vol. 22, ns. 1-9; 1915. 1819

Cajori, Florian. A history of mathematics, x+514 p. 2d ed. New York, MACMILLAN, 1919. 1819

A searching criticism of this new ed. (materially enlarged and rewritten) has been published by D. E. SMITH in the *Amer. Math. Mly.*, vol. 27, p. 120-127, 1920. SMITH's criticism can be summed up as follows. The general plan of the work is good and the amount of information it offers exceeds that to be found in any other general hist. of mathem. that has thus far appeared in English. Yet there are a great number of errors, most of which the author could have easily avoided. Moreover it could have been written and the proofs corrected, with greater care. There are many inconsistencies chiefly in the transliteration of Oriental names.
G. S.

Hugh - Hellmuth, H. v. Einige Beziehungen zwischen Erotik und Mathematik. *Imago. Zeitschrift f. d. Anwendung der Psychoanalyse auf d. Geisterwiss.*, t. 4, p. 52-68; 1915. 1818

« Die vorliegende Arbeit gehört zu denjenigen die geeignet sind, die Psychoanalyse zu diskreditieren... Vom rein wissenschaftlichen Standpunkt aus bietet sie keinen Gewinn weder für die Psychoanalyse noch für die Geschichte der Mathematik. » (H. WIELEITNER, *Mit. zur Gesch. d. Med.*, t. 15, p. 17-18; 1916). G. S.

Karpinski, L. C. Origines et développement de l'algèbre. *Scientia*, t. 26, p. 89-101; 1919. 1818

Loria, Gino. Il « Philosophical Magazine » e la storia delle matematiche. *Riv. stor. crit. sci.*, t. 7, p. 1-5; 1916. 1818

LORIA shows the importance of unearthing historical papers published in magazines of a non technical or general kind. He draws attention to important hist. notes publ. by THOMAS STEPHEN DAVIES (1794-1851) in the *London, Edinburgh and Dublin Philosophical Magazine and Journal of Science* » between 1848 and 1852. In an additional note, MIELI insists on the importance of such enquiries and proposes that all Italian periodicals be systematically searched. G. S.

Loria, Gino. Le matematiche in Portogallo. Ciò che furono, ciò che sono. *Scientia*, t. 26, p. 1-9; 1919. 1818

Moritz, Robert E. « Memorabilia Mathematica », or the Philomath's Quotation Book, VII+410 p. New York, MACMILLAN, 1914. 1818

See very detailed and critical review by R. C. ARCHIBALD in *Bull. Amer. Math. Soc.*, t. 22, p. 188-192; 1916. J.

Wilczynski, E. J. Some remarks on the historical development and the future prospects of the differential geometry of plane curves. *Bull. Amer. Math. Soc.*, t. 22, p. 317-329; 1916. 1818

To show how one fundamental idea has dominated and still dominates

differential geometry : « The notions, *osculant* and *penosculant* are the fundamental concepts of differential geometry. The systematic investigation of the magnitudes, loci and envelopes determined by the various classes of osculants and penosculants and the relations which exist between them makes up the whole subject of differential geometry. Differential properties of a general curve are merely integral properties of its osculants and penosculants. » J.

Frege, G. The fundamental laws of arithmetic. Psychological logic. *Monist*, t. 26, p. 182-199 ; 1916. 1819

Continuation of the translation of the preface of FREGE's Grundgesetze der Arithmetik, vol. I, Jena, 1893. J.

Gordin, H. M. Infinity and the Part-and-Whole axiom. Definitions of the fundamental entities of geometry. *Monist*, Oct. 1919, p. 1-11. 1813

Jourdain, Philip E. B. Mathematicians and Philosophers. *Monist*, t. 25, p. 633-638. Chicago, 1915. 1818

A contrast between the attitudes of mathematicians and philosophers towards logic. It is a fact that often mathematicians have been bad logicians, as is illustrated by the controversy about the infinitesimal calculus provoked by GEORGE BERKELEY, 1734. Another contrast between mathematicians and philosophers is given by the failure of philosophers' attempts to give an adequate theory of mathematics and the mathematicians' success in this. In modern times, a symbolic treatment of logic has grown up, and logicians show themselves very far behind mathematicians in the cultivation of mathematical logic. J.

Karpinski, Louis C. ; Harry Y. Benedict and **John W. Calhoun.** Unified Mathematics, VIII+522 p., many ill. and graphs. Boston, HEATH ; London, HARRAP, 1918. 1818

This course includes the main contents of ordinary elementary courses on algebra, trigonometry and analytical geometry, continuous emphasis being laid on the essential unity and harmony of these various branches of mathematics. Every pain is taken to show the relation of these abstract notions to the student's environment. At the end, many tables and good index. Most interesting undertaking the results of which it will be worth while to watch. G. S.

Loria, Gino Les noms et les choses. Remarques sur la nomenclature mathématique. *L'Enseignement mathématique*, t. 20, p. 237-244. Genève, 1919. 1818

Remarques sur les imperfections de cette nomenclature. Par ex. emploi abusif et multivoque de mots tels que : ordre, classe, genre, espèce, module, polaire, involution, axe, forme, foyer, réciprocité, congruence. Aussi emploi erroné de noms propres : théor. de D'ALEMBERT, théor. de THALÈS, coordonnées cartésiennes, courbe de ROLLE, etc. G. S.

Shaw, James Byrnie. Lectures on the philosophy of mathematics, VII+206 p. Chicago, Open Court, 1918. 1818

Staeckel, Paul. Beiträge zur Kritik der Differentialgeometrie, *Sitzungsber. d. Heidelb. Akad. d. Wissensch., Math. Kl.*, Bd. V A, 27 S., 1914. 1819

20. — MECHANICS

Brose, Henry L. The Theory of Relativity. An introductory sketch based on Einstein's original writings, 32 p. Oxford, BLACKWELL, 1919. 1918

Cunningham, Ebenezer. EINSTEIN's relativity theory of gravitation. *Nature*, t. 104, p. 354-356, 374-376, 394-395. London, 1919. 1918

Dyson, Frank, and **A. C. Crommelin, A. S. Eddington,** Sir **Joseph Thomson.** The deflection of light by gravitation and the EINSTEIN theory. *Scientific Monthly*, t. X, p. 79. New York, 1920. 1918

Reprinted from *The Observatory*.

Einstein, Albert. Time, Space and Gravitation. *Science*, t. 51, p. 8-10, New York, 1920. 1918

Reprinted from the London *Times*.

Ichak, Fr. Das Perpetuum Mobile. 98 S., 38 Abb. (Aus Natur und Geisteswelt.) Leipzig, TEUBNER, 1914. 1918

Tolman, Richard Chace [1881-]. The theory of the relativity of motion, IX+225 p. University of California Press, Berkeley, 1917. 1918

Historical survey at the beginning. G. S.

Wilson, Edwin B. Space, Time and Gravitation. *Scientific Monthly*, t. 10, p. 217-235. New York, 1920. 1918

21. — MEDICINE

A. — *History, Organization and Philosophy*

Corsini, Andrea. I medici navali nell' evo antico e medio. *Annali di medicina navale e coloniale*, Anno 22, vol. 2. 32 p. Roma 1916. 1918

Fedeli, Carlo. Le scuole di storia della medicina nell' università di Pisa. *Archivio di storia della scienza*, t. I, 141-150, Roma 1920. 1918

Hansemann, David Paul von. Der Aberglaube in der Medizin und seine Gefahr für Gesundheit und Leben. 2te Aufl., 116 S. (Aus Natur und Geisteswelt) Leipzig, TEUBNER, 1914. 1918

Johnsson, J. W. S. Personalgeschichte der dänischen Aerzte. *Mit. zur Gesch. d. Med.*, t. 15, p. 183-184, 1916. 1918

Martin, Alfred. Gebärlage der Frau, Bad des Neugebornen und Wochenbett in Mitteleuropa auf Grund bildlicher und textlicher Darstellung. *Archiv f. Gesch. d. Med.*, t. X, p. 209, 1917. 1918

Deals with European birthcustoms as portrayed in Renaissance literature. A fairly extensive bibliography. C. S.

Martin, Alfred. Sympathische Heilungen durch bestimmte Personen und Heilung durch Arznei aus Fürstenhand. *Medizinische Klinik*, Nr. 47, 1 S.; 1915. 1918

M. shows that there is a connection between these two kinds of superstitions. Bibliography. G. S.

Riesman, David. The rise and early history of clinical teaching. *Annals of medical history*, t. 2, p. 136-147. New York, 1919. 1818

Vierordt, Hermann. Medizin-geschichtliches Hilfsbuch mit besonderer Berücksichtigung der Entdeckungsgeschichte und der Biographie. VII + 469 S. Tübingen, LAUPP, 1916. 1818

This book contains two parts : I. List by authors of remarkable medical books and writings (p. 1-326); II. List of authors with short biographical information. This compilation which seems to have been made with great care, will be very useful to trace quickly some important medical work. An elaborate subject index increases its usefulness. It would have been simpler to mix the two parts giving for each author successively biogr. and bibliogr. information. G. S.

Walsh, James J. Two chapters in the history of laryngology and rhinology. *Annals of medical hist.*, t. 2, p. 23-33. New York, 1919. 1818

Discursive and paradoxical essay dealing with laryngology in New York in the latter half of XIX, mediaeval medicine, anaesthesia, etc. See SINGER's review of W.'s ideas on mediaeval medicine, *Isis*, III, p. 306. G. S.

Zaunick, Rudolph. Beitrag zur Geschichte der Heilkraft der Kröte. *Mit. zur Gesch. d. Med.*, t. 15, p. 78-79; 1916. 1818

B. — *Epidemiology. History and Geography of Diseases*

Flexner, Simon. Epidemiology and recent epidemics. *Science*, vol. 50, p. 313-319. New York, 1919. 1818

Johnsson, J. W. S. Medizinisch-historische und epidemiologische Literatur über Grönland. *Mit. zur Gesch. d. Med.*, t. 14, p. 42-43; 1915. 1818

23. — PHARMACY AND PHARMACOLOGY

Schoeffler, Herbert. Antioche. *Mit. zur Gesch. d. Med.*, t. 17, p. 83; 1918. 1818

Verwendung des Namens der Kreuzfahrerstadt Antiochia in Medikamentbezeichnungen. G. S.

24. — PHILOSOPHY. SCIENCE AND PHILOSOPHY. HISTORY OF PHILOSOPHY.

Silberer, Herbert [1882-]. Probleme der Mystik und ihrer Symbolik. Wien, H. HELLER, 1916. 1818

I have not seen this book but simply an English translation : Problems of mysticism and its symbolism, transl. by SMITH ELY JELLIFFE, V + 451 p. New York, MOFFAT, 1917. Moderately Freudian. G. S.

25. — PHYSICS

Crew, Henry. The scientific leadership of the world. *The methodist Review*, p. 95-102. New York, Jan. 1920. 1818

List of 233 main achievements in physics during the last 300 years, the

purpose being to ascertain the part played by each nation in the progress of physics. The numbers of discoveries which can be credited to each nation are respectively : British 70, German 48, French 40, American 33, Dutch 12, Italian 11, Swiss 8, Danish 4, Russian 3, Swedish 3, Austrian 1. G. S.

Haas, Arthur Eric. Der Wert der geschichtlichen Methode im physikalischen Unterricht. *Zeitschrift f. math. u. naturw. Unterricht*, t. 45, p. 281-286. Leipzig, 1914. 1319

Lippmann, Edm. O. von. Zur Geschichte der Volumgewichts-Ermittlung. *Chemiker Zeitung*. p. 985. Cöthen, 1915. 1318

Criticism of article published *ibidem*, p. 913 by H. SCHELENZ under same title. Important. G. S.

Wuerschmidt, J. Zur Geschichte, Theorie und Praxis der Camera Obscura. *Zeit. f. math. u. naturw. Unterricht*, Bd. 46, S. 466-476. Leipzig, 1915. 1318

Wien, W. Vorträge über die neuere Entwicklung der Physik und ihrer Anwendungen. Gehalten im Baltenland im Frühjar 1918 auf Veranlassung des Oberkommandos der achten Armee, IV + 116 S. Leipzig, BARTH, 1919. 1318

26. — PHYSIOLOGY

Crawfurd, Raymond. Of superstitions concerning menstruation. *Proc. R. S. of med., hist. section*, t. 9, p. 49; 1916. 1318

Traces these beliefs from primitive to modern times in connection with magic, milk supply, crops, etc. C. S.

27. — PREHISTORY

Baudouin, M. L'ostéoarthrite déformante chronique à l'âge de la pierre polie. *Bull. Soc. franç. hist. med.*, t. 13, p. 96; 1914. 1318

Describes bones taken from 16 neolithic skeletons in the ossuary of Bazoges-en-Pareds (Vendée) exhibiting signs of osteoarthritis. C. S.

Franchet, L. Les éléments chronologiques en archéologie. *Revue scientifique*, p. 331-334. Paris, 1919. 1318

Hoefler, M. Ein alter Heilritus. *Arch. f. Gesch. d. Med.*, t. 7, p. 390; 1914. 1318

There is a well known piece of Palaeolithic sculpturing originally publ. by E. PIETTE (*L'Anthropologie*, t. 6, pl. V, 4, 1895) presenting the outline of the body of a pregnant woman and the hind leg of a reindeer. H. points out that the genitalia are represented in the carving. The fig. which is recumbant is perhaps holding the branch of a tree. H. is inclined to regard the piece of reindeer bone on which the scene is carved as of the nature of a talisman for use in some birth or fertility rite. C. S.

Moetefindt, Hugo. Reparatur in vorgeschichtlicher Zeit. *Geschichtsbl. f. Technik*, t. 1, p. 144-152; 1914. 1318

28. — PSYCHOLOGY

Ebstein, Erich. Zur Vorgeschichte der Aphasie. *Mit. zur Gesch. d. Med*, t. 17, p. 172-173, 1918. 1818

Révész, Béla. Geschichte des Seelenbegriffs und der Seelenlokalisation. 310 p. Stuttgart, ENKE, 1917. 1818

29. — RELIGION. HISTORY OF RELIGION. RELIGION AND SCIENCE

Moore, George Foot. History of Religions. II. Judaism, Christianity, Mohammedanism, XVI + 552 p. New York, SCRIBNER, 1919. 1818

30. — SCIENCE

B. — *History*

Daniels, Francis. French scientific Reader, edited with introduction, notes and vocabulary. (Oxford French Series), XVIII + 748 p. New York, Oxford University Press, 1917. 1818

Del Lungo, Carlo. Il Museo di fisica e di storia naturale di Firenze ed il museo degli strumenti antichi di fisica e di astronomia. *Archivio di Storia della Scienza*, t. 1, p. 153-156. Roma, 1920. 1818

Mieli, Aldo. Per una biografia degli storici della scienza italiani. *Riv. stor. crit. sci.*, t. 7, p. 59-60, 86, 125-127, 165-167; t. 8, p. 225-227, 250-251, 320-323; 1916-1917. 1818

Bio- and bibliogr. notes about RAFFAELLO CAVERNI (1837-1900), STANISLAO CANNIZZARO (1826-1910); FRANCESCO PUCCINOTTI (1794-1872), SALVATORE DE RENZI (1800-1872); BALD. BONCOMPAGNI (1821-1894), GIOV. VAILATI (1863-1909), CARLO PIGLI (1802-1860), GIUSEPPE CERVETTO (1808-65). G. S.

Mieli, Aldo. Sul concetto di storia della scienza. Appunti introduttivi. *Riv. stor. crit. sci.*, t. 7, p. 42-46, 88-89; 1916. 1818

The history of science as understood and defined by GINO LORIA, GEORGE SARTON, ALDO MIELI. G. S.

Mieli, Aldo. Bibliografia metodica dei lavori di storia della scienza publicati in Italia. *Archivio di Storia d. Scienza*, I, p. 195-217; 1920. 1818

The first of a series of Critical Bibliographies constructed on the same plan as those published in *Isis*, but restricted to books and papers which are published in Italy or in Italian or deal with Italian science. Our very best wishes! G. S.

Miller, G. A. The historical point of view in the teaching of science. *Science*, vol. 50, p. 489-493. New York, 1919. 1818

Petronievics, Branislav. Slav achievement in advanced science, 32 p. London, The American Book supply Co., 1917. 1818

Biographies of the Pole NIKLAS KOPERNIGK, the Russians DIMITRIJE IVANOVITCH MENDELJEW and NIKOLAJ IVANOVITCH LOBATCHEVSKI and the Serbo-Croat RUDJER JOSIF BOSHCOVIC. The transcription of names is the author's. The work of these four men is described clearly and popularly but at slightly greater length than is done in most popular works. Perhaps the best account is the exceedingly interesting summary of the work of BOSHCOVIC. J.

Sarton, George. Secret History. *Scribner's Magazine*, vol. 67, p. 187-192. New York, 1920. 1818

Showing the relation of the development of science to the development of civilization and to the New Humanism. To explain the word « secret » in the title, I quote the last paragraph : « The advance of civilization is due neither to the people nor to their ruling and dominating class of whatever kind. It is due to the untiring efforts of a small, unobtrusive and powerless aristocracy of scientists and artists. This is an aristocracy, not of privileges, but of service. The history of man's progress is to a large extent the yet unknown and secret history of this aristocracy. » G. S.

Sarton, George [Report to the Trustees of the CARNEGIE Institution on his work in 1918-1919]. Year Book no. 18 of the CARNEGIE Institution of Washington for 1919, p. 347-349. Washington, 1920. 1818

(1) LEONARDO Studies ; (2) History of Physics; (3) History of Science; (4) History of the Institution. G. S.

Stein, Robert. Naturwissenschaft in Utopia. *Deutsche Geschichtsblätter*, t. 17, p. 48-59 ; 1916. 1818

C. — *Organization*

Hale, George Ellery. Cooperation in Research. *Science*, vol. 51, p. 149-155. New York, 1920. 1819

Woodward, Robert S. The needs of research. *Science*, vol. 40, p. 217-229. New York, August 1914. 1818

Address read at the Dedication of the Marine Biological Laboratory, Woods Hole, Mass., July 10, 1914. At that time there were in the U. S. about 600 degree-giving establishments having an aggregate annual income of more than a 100 mill. dol. and employing more than 30,000 officials, against less than half a dozen independent research organizations having less than 2 mill. dol. annual income and employing less than 500 investigators. G. S.

Woodward, Robert S. Smithsonian Geographical Tables. Third edition reprinted, CVI+182 p. Washington, Smithsonian Institution, 1918. 1818

Preface first ed. dated 1894; 2d ed. 1897; 3d ed. 1906 The reprint of 1918 is identical to the 3d ed. but for a note on p. 1. This book is far more comprehensive than its title suggests, as it contains the following matters : Useful mathem. formulas. Mensuration. Units of measures and weights. Geodesy. Theory of errors. Then 42 tables (math., geogr., astron.). An appendix is devoted to the constants : numerical, geodetical, astronomical and physical. Synoptic conversion of English and Metric units. Dimensions of physical quantities. An extraordinarily valuable and handy book. G. S.

D. — *Philosophy*

Enriques, Federigo. Problems of Science. Authorized translation by KATHARINE ROYCE. With an Introductory Note by JOSIAH ROYCE, XVI+392 p. Chicago and London, The Open Court Publishing Co., 1914. 1818

This is a translation of ENRIQUES's *Problemi della Scienza*, of which the

first Italian edition appeared in 1906. In the introductory note, J. ROYCE points out that this work of synthetic scientific methodology « stands somewhat above and apart from those philosophical controversies which the anti-intellectual movement [of JAMES and BERGSON] has inspired », and contrasts ENRIQUES's tendency with the tendencies just referred to. J.

Mach, Ernst. Erkenntnis und Irrtum. Skizzen zur Phsychologie der Forschung. 3te durchgesehene Auflage. XI+483 p. Leipzig, BARTH, 1917. 1818

Mach, Ernst. The Analysis of Sensations and the Relation of the Physical to the Psychical, translated from the first German edition by C. M. WILLIAMS, revised and supplemented from the fifth German edition by SYDNEY WATERLOW, M. A., XVI+380 p. Chicago and London, The Open Court Publishing Company, 1914. 1818

This new, revised, and enlarged edition of MACH's Analysis of Sensations is a book nearly twice as long as the English translation of 1897. The eight chapters of the original edition have all been greatly expanded, and there are six new chapters on « My relation to AVENARIUS and other thinkers », « Physics and Biology », « The Will », « Biologico-Teleological Considerations as to Space », « Sensation ». « Memory and Association » and « How my Views have been received ». The author amplifies and brings up to date his original discussions on points of detail and explains and justifies his more general views as to the relation between different branches of science and as to questions on the borderland between science and philosophy. Particular interest attaches to the explanations which he now gives of the way in which his views were developed. This is one of the most important of MACH'S works, and the present edition has been most competently translated and revised. J.

Soddy, Frederick. Science and Life. Aberdeen Addresses, XII+229 p. London, Murray, 1920. 1818

Stein, Robert. Naturwissenschaftliche Philosophien. Eine terminologische Studie. *Mit. zur Gesch. d Med.*, t. 16, p. 11-18; 1917. 1818

Study on the use of the word philosophy, philosophia, etc. in connection with the name of some branch of science. Additional information was given by MARTIN W. NEUFELD and STEIN himself, *Ibidem*, p. 259-260, 427-531. G. S.

Westaway, F. W. Scientific Method. Its philosophy and its practice. New edition, XXII+426 p. London, BLACKIE, 1919. 1818

32. — STATISTICS

Niceforo, Alfredo. La Misura della Vita. Applicazioni del metodo statistico alle scienze naturali, alle scienze sociali e all' arte, XII + 515 p., con 112 tab. e 29 diagr. Torino, BOCCA, 1919. 1818

34. — TECHNOLOGY

(for mining, see geology; for industrial chemistry, chemistry. See also arts and crafts)

Barber, Herbert Lee [1865-]. Story of the automobile. Its history and development from 1760 to 1917 with an analysis of the standing and prospects of the automobile industry, 250 p., 3 portr. Chicago, MUNSON, 1917. 1818

Feldhaus, Franz M. Der Laie als Erfinder. Mit einem Vorwort von Hugo E. Bremer. *Geschichtsbl. f. Technik*, t. 5, p. 1-53. Berlin, 1918 1818

The idea of this essay is excellent : to show the importance of inventions made by isolated laymen *versus* those introduced by the great industrial corporations. Incidental criticism of the German patent system. Some means must be found to protect and foster the inventive genius, the greatest asset of any nation. The idea is very well carried out, F. being able to marshall a large amount of facts in its support. This is an excellent contribution to the sociological study of invention. The many inventors considered are classified according to their professions, 13 chapters being devoted each to one profession. No index. G. S.

Feldhaus, Franz M. Die Wirkungsweise antiker Blasbälge. *Mit. zur Gesch. d. Med.*, t. 15, p. 10-12, 2 Abb.; 1916. 1818

Geitel, Max. Schöpfungen der Ingenieurtechnik der Neuzeit, 106 S., 32 Abb. (Aus Natur und Geisteswelt). Leipzig, Teubner, 1914. 1818

Geschichtsblätter für Technik und Industrie. Illustrierte Monatschrift mit dem « Beiblatt für die literarischen Abteilungen der Industrie ». Herausgegeben von Graf Carl v. Klinckowstroem und Ingenieur Franz M. Feldhaus. Band V, 1918 mit 26 Abbildungen, 326 p., 8 pl. Berlin-Friedenau, Verlag der Quellenforschungen zur Geschichte der Technik und Industrie. 1818

This is the periodical founded in 1914 under a slightly different title. See *Isis*, II, 459. The first title was also used for vol. II (1915). From vol. III on the *Beiblatt* is added. From vol. V (1918) on the words « und Gewerbe » are suppressed in the title. — The « Geschichtsblätter » contain an enormous amount of material but unclassified and very unsatisfactorily indexed (vol. V has no index?). The only way to make full use of the materials offered is to put them on cards, as the editors do! Yet I suppose we must be grateful to them for publishing their rough notes, even if we wish that they would offer them in a more graceful way. The most important articles or notes are classified in our Bibliography; the greatest number however are too fragmentary to be included. G. S.

Horwitz, Hugo Theodor. Entwicklungsgeschichte der Traglager. *Geschichtsbl. f. Technik*, Bd. I und II (passim). Berlin, 1914-1915. 1818

Also publ. in book form, same title, x+137 p., 82 Fig. Berlin, Fr. Zillessen, 1915. Many errors are corrected in the book form edition. G. S.

Horwitz, Hugo Theodor. Die Geschichte der Technik und die Sprachforschung. *Geschichtsbl. f. Technik*, t. 3, p. 16-19; 1916. 1818

Kobert, R. Beiträge zur Geschichte des Gerbens und der Adstringentien. *Archiv f. Gesch. d. Naturw. u. d. Technik*, t. 7, p. 185-206; 1916. 1818

Illustr. article on the development of leather-dressing. Contents : Introduction. — Ancient East. — Greeks and Romans. — On a forgotten tanning substance of Dioscorides. — Ancient Germans. — Leather of German origin among the ancient Germans. — Middle Ages. — Development of the leather industry in Rostock. — Most recent development. C. S.

Niemann, W. Weitere Beitraege zur Geschichte des Beleuchtungswesens. *Geschichtsbl. f. Technik*, t. 5, p. 137-141; 1918. 1818

De Monconys, 1646, 1664. Leonardo da Vinci. Denoyr, 1759. Ramiqurau, 1755. Commart, 1798. Bapt. de Thiville, 1880. G. S.

35. — ZOOLOGY

Dendy, Arthur (editor). Animal life and human progress. IX+227 p. London, Constable 1919. 1818

Lectures by various scientists at King's College 1917-1918.

Gudger, E. W. A historical note on the synchronous flashing of fire flies *Science*, vol. 50, p. 188-190. New York, 1919. 1818

First observed in Siam by Engelbert Kaempfer in 1690 and described by him in his History of Japan. G. S.

Gudger, E. W. History of the Spotted Eagle Ray, *Aëtobatus Narinari* together with a study of its external structures. Papers from the Tortugas Laboratory, vol. VI, p. 243-323, X pl. Washington, Carnegie Institution. 1818

The earliest reference to the Spotted Eagle Ray is by Claude d'Abbeville, Paris 1614. G. S.

Mullens, William Herbert [1866-] and **Swann, H. Kirke.** A bibliography of British ornithology from the earliest times to the end of 1912, including biographical accounts of the principal writers and bibliographies of their published works. Issued in 6 parts, XX+673 p., p. 673 691, leaves numbered on one side only. London, Macmillan 1916-1917. 1818

Southwell, T. and **Prashad, B.** Embryological and developmental studies of Indian fishes. *Records of the Indian Museum*, XVI, p. 215. Calcutta, 1919. 1818

The paper is important for its discussion in Section IV (p. 223) of intrauterine embryos Selachians. These interesting forms first investigated by Aristotle were generally neglected until many of the Aristotelian observations, including the placenta formation, were again verified hy Joh. Müller in 1840. Much interest has since been shown in the viviparous Elasmobranches. The material however is difficult to investigate and these observations on a variety of forms are valuable in verifying and extending further Aristotle's and Müller's observations. C. S.

Zaunick, Rudolph, Bitte um Mitteilungen über Fischereihandschriften. *Mit. zur Gesch. d. Med.* t. 15, p. 193-195; 1916. 1818

Appeal for information on incunabula and Mss. dealing with fishing and fishery. G. S.

Zaunick, Rudolph. Gründung einer Hagen-Gesellschaft für die Bibliographie der entomologischen Literatur. *Mit. zur Gesch. d. Med.*, t. 17, p. 177; 1918. 1818

Very short note to announce an appeal made by Georg von Seidlitz of Ebenhausen nr. Munich, Bavaria to found an Hagen Society, whose aim would be to complete and keep up-to-date Hermann August Hagen's (1817-1893) Bibliotheca Entomologiae, Leipzig 1862. G. S.